

What Housing Assistance Support Recipients Report as Rent and How They Sort Out, as Indicated by Record Linkage

W. Ward Kingkade
Social, Economic and Housing Statistics Division
U.S. Census Bureau

SEHSD Working Paper Number 2019-37

A summary of this paper was presented at the Annual Joint Statistical Meetings, Baltimore, July 27-August 3, 2017.

This report is released to inform interested parties of ongoing research and to encourage discussion of work in progress. It has been reviewed and cleared for nondisclosure of personally identifiable information. The views expressed on (statistical, methodological, technical, or operational) issues are those of the author and not necessarily those of the U.S. Census Bureau.

U S C E N S U S B U R E A U

Helping You Make Informed Decisions

Introduction

Housing is a basic necessity in life, and expenditures on housing usually figure prominently in a household's budget. Enabling low-income households to cover their housing costs is an important component of the social safety net. The ability of such households to afford housing is taken into account in measures of poverty such as the Census Bureau's Supplemental Poverty Measure (Renwick and Fox, 2016; Renwick, 2011; Short, 2014).

Monthly rent is a question asked of householders in the American Community Survey (ACS).¹ How to interpret responses to this item, in particular, whether they indicate the out-of-pocket expenditure of the household for rent or the total rental cost of the dwelling unit has been a matter of uncertainty in analyses involving ACS respondents who receive housing subsidies. In principle, householders can be expected to know, at least roughly, how much they pay for rent per month. Whether ACS recipients of housing support report the fully subsidized rent is another matter. This question is compounded by the fact that the instructions on whether to include the housing subsidy vary by mode of interview.²

¹ The ACS is a nationwide survey designed to provide communities with reliable and timely demographic, social, economic, and housing data for the nation, states, congressional districts, counties, places, and other localities every year. It samples 3.5 million housing units annually. The present analysis is limited to the continental US, in which the ACS is conducted in every county. For information on sampling error, non-sampling error, and confidentiality protection in the ACS, see <https://www.census.gov/programs-surveys/acs/technical-documentation/code-lists.html>.

² The ACS instruction pamphlet included with the paper questionnaire and the help instructions for Internet Self-Response instruct the respondent to "Report the rent agreed to or contracted for, even if the rent for your home, apartment, or mobile home is unpaid or paid by someone else." In contrast, the ACS help screen instructions for telephone or personal interviews contain the same sentence, followed immediately by "Do not include any subsidy amount which may be paid by a local housing authority or other agency." This has been corrected as of data year 2017 so that instructions for all modes of interview contain the injunction not to include government subsidies.

The linked data

Previous research conducted at the Census Bureau (Kingkade, 2017) indicates that a majority of ACS respondents who are recipients of housing support tend to report rents that are closer to their out-of-pocket expenditures, but finds that this varies by the category of assistance program through which they are supported. The present analysis pursues this question in greater detail, and also examines the factors that influence who among ACS recipients of housing support reports an ACS Rent closer to the household's monthly outlay on housing as opposed to one that is closer to the amount the unit actually rents for with the subsidy included. This is done in a bivariate and multivariate context employing a dataset in which household records from the 2012 and 2013 ACS housing unit samples have been matched to records for the same households in a dataset constructed from excerpts of databases held at the Department of Housing and Urban Development (HUD) as of the end of March 2013.³ The HUD data provide alternative measures of monthly rent that can be compared to the ACS measure of monthly rent, and also include a number of program-related attributes along with individual and household background characteristics. The analysis relies on the Survey package in R, developed and maintained by Thomas Lumley for the analysis of data from complex survey designs (Lumley, 2014), which accommodates the replicate weights employed with the ACS.

Two rent concepts are distinguished in the HUD data: Contract Rent, and Total Tenant Payment (TTP). The latter is the amount paid out by the tenant household and generally amounts to 30 percent of the household's income, with adjustments for expenses due to dependents and household members requiring special care, as well as other relevant circumstances. The Contract Rent is the rent received by the property owner or designee thereof. It is equal to the TTP plus the HUD subsidy. Thus, the

³ The majority of household certifications in the HUD data date to the first quarter of 2013 and the last quarter of 2012. However, the certification dates range further back in time to the beginning of 2012 or earlier.

question about the ACS Rent item is equivalent to the question of whether ACS housing support recipients are reporting their Contract Rents or their TTPs.

The linkage of the datasets was conducted using Personal Identification Keys (PIKs), which unambiguously reference individuals and are intended for use across datasets (Wagner and Layne, 2014). These were assigned to person records in the database excerpts received from HUD by the Census Bureau through methods of statistical record linkage (Herzog et al., 2007). For the ACS, the Census Bureau produced tables of correspondence (“crosswalks”) obtained by related methods (ibid.), which relate PIKs to the ACS Continuous Measurement Identification numbers (CMIDs) of households and person numbers, so that individuals in the ACS can be assigned a PIK. We employed these crosswalks to associate PIKs with records on the ACS person files having the same CMIDs and person numbers, which uniquely identify individual respondents in the ACS. We then selected those records pertaining to householders, retaining in addition sex and employment status, because these items are not included in the set of householder characteristics on the ACS housing unit datasets and were of interest to the analysis. Finally, the selected records were then matched on their CMIDs to the ACS housing unit sample file, eliminating any instances of duplicate PIKs.⁴

It should be mentioned at this point that the 2013 HUD data come in two separate files, one pertaining to the Public and Indian Housing Center (the PIC file) and the other to the Tenant Rental Assistance Certification System (the TRACS file). Both datasets were assigned PIKs by the Census Bureau and both contain the same measures of Contract Rent as well as TTP. To enhance the usefulness of the HUD data at our disposal and facilitate future analyses, we retained as many additional variables as we reasonably could. For the most part, the contents of the two HUD files are similar, but in some

⁴ In eliminating duplicates, all records having the same PIK were deleted, because it is not clear which record is the correct one.

instances it was necessary to reconcile the metrics of variables such as race, which is measured in the five Office of Management and Budget categories⁵ on the PIC file, but includes a sixth “Other Race” category in the TRACS file. We were able to construct a least common denominator multiple race variable distinguishing the 31 possible combinations of the 5 categories⁶. We also retained a 6-category TRACS multiple race variable, because it is parallel to a similar item afforded by the ACS. In the same vein, age is present in single years on the PIC file, and this measure displays better properties than the difference between certification and birth dates. However, the latter two date variables are all that is available for measuring age in the TRACS data, so we found it expedient to compute exact age in the TRACS data by subtraction of dates, then rounding to years to obtain a measure comparable to the PIC file’s age-in-years variable. Prior to the match to the ACS, we merged the PIC and TRACS files for 2013.⁷

Just prior to the reconciliation of measures, we aggregated the PIK and TRACS files to the household level. In order to identify household heads and differentiate households in the HUD data, the Census Bureau assigned “Quick PIKs” (QPIKs) of the household head⁸ to each individual record on both files, and we used this item to construct the household records. Unlike PIKs, which maintain their integrity across datasets, QPIKs do not, so the aggregation to the household level had to be done a step ahead of combining the PIC and TRACS datasets. In the aggregation, we retained the individual

⁵ These are: White, Black, American Indian and Alaska Native, Asian, and Native Hawaiian and Other Pacific Islanders.

⁶ A nonresponse on all 5 categories was treated as an invalid response and does not have a corresponding multirace category.

⁷ There were no instances of the same PIKs shared in common between the two files for 2013. We considered it prudent to check for this possibility, which may occur in other years.

⁸ This is the terminology employed in the HUD data files and documentation, as well as program descriptions. We were constrained to make the (not unreasonable) assumption that HUD household heads were equivalent to ACS householders, but as indicated below, we checked this to the extent possible by comparing personal characteristics of the individuals in question on matched records.

characteristics of the HUD household head, and computed household-level aggregate measures such as number of members and the range of their ages. Most variables in the HUD PIC and TRACS files pertain to the household and are repeated for each individual member.

Merging the HUD combined dataset to the PIKed 2012 and 2013 ACS housing unit files involved some removal of duplicates on the ACS side.⁹ We retained most variables in the HUD data even when a parallel ACS item was available, as in the instance of age. This was done deliberately to enable us to exclude instances of probably false matches. For instance, when the sex of the ACS householder differs from that of the HUD household head, regardless of which is right or wrong, it seems likely that we are not matching records for the same individual. Because the ACS PIK crosswalks were constructed based on characteristics such as address and name, they may well be subject to a greater degree of error than is present in the PIKs assigned to the HUD data, which are based on social security numbers. In any case, it is difficult to altogether rule out the possibility of mismatches, so we anticipated that some would be encountered.

As indicated, prior to obtaining the results described below, we made a series of exclusions of records from the merged ACS-HUD dataset whose construction has just been described, in total:

- 1) All instances in which the sex of the ACS householder failed to match the HUD household head were excluded;
- 2) Cases in which the ACS householder's age differed from that of the HUD household head by more than two years were rejected, based on our observation that in the overwhelming majority of instances the age difference is within one year, and the frequencies of age differences greater than two years are vastly lower than the frequencies of age differences of two years or less;

⁹ The assignment of PIKs to the individual-level HUD data was based on a more certain identifier variable than can be obtained at the individual level in the ACS data, so it is not surprising that more instances of duplicate PIKs were found in the ACS files with crosswalked PIKs.

- 3) Terminations and moveouts from the certifying HUD jurisdictions were eliminated;
- 4) Households that moved into the HUD-certified subsidized unit after the ACS interview were also eliminated to avoid comparisons involving two different dwelling units;
- 5) Instances in which the ACS Rent was imputed were rejected because the intent of the present analysis is to investigate actual responses on the part of householders to the ACS item rather than estimates of rent obtained some other way;
- 6) Instances in which household income was imputed were excluded;
- 7) Instances in which employment status was imputed were excluded;
- 8) All instances of negative TTPs were excluded;
- 9) Certifications flagged by HUD as “inactive” were of no interest to this analysis;
- 10) The analysis was also restricted to cases in which the ACS interview and the HUD certification took place within two years (730 days) of each other;
- 11) Households in any HUD programs in which there is no Contract Rent measure available, most notably the numerically important (conventional) public housing category, along with homeownership voucher programs, were excluded because they afford no option to compare proximity of the ACS response to Contract Rent in contrast to TTP, inasmuch as the former is not measured;
- 12) Finally, records containing a missing value on any of the analysis variables entering into the maximal GLM described below, as well as duration of residence in months, were excluded.¹⁰

¹⁰ Duration of residence was initially considered as an independent variable in a “super maximal” GLM, and also as a factor to be compared between the HUD and ACS datasets. We regard it as a member of our set of analysis variables, and it is mentioned below in the context of directions for future research.

These exclusions reduced the number of records to be analyzed by about 66 percent, from approximately 120,000 to roughly 40,500, due mainly to HUD program exclusions¹¹, imputation exclusions, and exclusions of instances in which analysis variables are not ascertained, but still leave us with a comfortable amount for this analysis.

Analysis

We begin the analysis by considering the differences of HUD Contract Rent and TTP from ACS Rent, as reported by or recorded for the same householders. Figure 1 presents the distribution of differences between the ACS Rent reported by the householder and the Contract Rent for the same household registered by HUD. Each bar in the histogram has a width of \$50, centered at zero and proceeding outward in either direction in intervals of \$50. The distribution has a distinct protruding bar around the modal value of zero (no difference)¹², but otherwise, most of the differences are negative (about 72 percent of all the differences). This suggests that most householders are reporting in the ACS less rent than the Contract Rent according to HUD. Figure 2 portrays the distribution of differences between ACS Rent and HUD TTP measured for the same householders. This distribution also features a protruding bar centered on \$0 and a neighboring bar centered around \$-50. Otherwise, most of the differences are positive (about 52 percent of all the differences), indicating a substantial density of householders reporting a rent in the ACS that is higher than TTP. The median difference between ACS Rent and HUD TTP is four dollars, while the median difference of HUD Contract Rent from ACS Rent is -325 dollars. Overall, the balance favors TTP in terms of proximity to the ACS item. However, the histograms suggest that the situation is not that simple. There appear to be two contingents of

¹¹ A total of roughly 28,000 records were lost from this source alone, mainly due to the large public housing contingent.

¹² This statement refers to the difference in responses on the part of the Householder/HUD Household Head to the ACS Rent item and the HUD Total Tenant Payment item measured in single dollars. Zero is the dollar difference associated with the highest frequency of these respondents.

householders, one reporting ACS Rent close to their HUD Contract Rent, and the other an ACS Rent close to their TTP. Figure 2 further indicates that a substantial share of respondents fall somewhere in between.

The Binary Variable

To measure whether ACS respondents' reported rent is closer to their HUD Contract Rent or closer to their TTP, we construct a variable indicating which of the two respective HUD measures the ACS response comes closer to. From this point on, we analyze a dichotomous variable that equals 1 when the ACS Rent is closer to the HUD Contract Rent than the HUD TTP, equals 0 when the ACS Rent is at least as close to the TTP as it is to the Contract Rent, and is set to missing when any of the variables going into the comparisons is missing. This dichotomy is analyzed in a bivariate and multivariate context in the analysis which follows.

HUD Program Category

HUD administers a variety of programs providing assistance to low income families in securing housing (US Department of Housing and Urban Development, 2016). These programs vary widely in the population contingents they serve and the degree of initiative required on the part of the participant residents.¹³ Conventional Public Housing is provided to recipients who qualify for admission into housing projects at the referral of Public Housing Authorities (PHAs). At the opposite extreme, Homeownership Vouchers assist recipients in paying off mortgages for homes they have found, while Tenant Based Vouchers assist recipients in covering the rental costs of housing they have found that meets HUD's stipulations. Previous research has identified a clear association between HUD program

¹³ The HUD program categories also vary widely in size. Some programs are experiments having little prospect of further development, whose participants are being "grandfathered along" in the residences they occupied under the program. Three of our program categories (Public Housing, Tenant Based Vouchers, and Section 8 NOS) encompass roughly 90 percent of recipients of HUD support registered in the HUD datasets (Kingkade, 2017).

category and which of the two rent constructs (Contract Rent, TTP) the ACS Rent response is closest to (Kingkade, 2017).

Figure 3 illustrates the proportion of ACS householders in the present analysis reporting a rent closer to their HUD Contract Rent than their TTP for seven categories of HUD programs.¹⁴ The patterns in the figure are in overall conformity with the results of previous research (Kingkade, 2017). Programs in which the initiative is on the tenant to locate affordable housing, such as the Tenant Based Vouchers, along with Section 236, in which tenants may pay up to the HUD-defined “market rent”, feature majorities of participating ACS householders whose reported rent is closer to the HUD Contract Rent than the TTP.¹⁵ In both the Section 8 NOS¹⁶ and Housing for the Elderly program categories, the proportion closer to the Contract Rent is less than 10 percent, but greater than zero percent.¹⁷

Mode of Interview

Figure 4 depicts the proportion of ACS householders reporting a rent closer to HUD Contract Rent than TTP by mode of interview. Householders who responded by internet distinguish themselves with by far the highest proportion (about 50 percent) reporting an ACS Rent closer to their HUD Contract Rent than their TTP. Roughly 40 percent of householders who responded by mail or were interviewed in person are closer to Contract Rent on this measure. This is the case for only around 30 percent of telephone interviewees in our analysis.

¹⁴ See Appendix A for a list of the HUD program categories used in this analysis, and Appendix B for a detailed description of the program categories in the HUD data.

¹⁵ The proportions for both categories of HUD program differ from 0.5 with high statistical significance ($p < .001$). Throughout this paper, we adhere to the $p < .05$ criterion for statistical significance, unless otherwise stated.

¹⁶ “NOS” is an abbreviation for Not Otherwise Specified.

¹⁷ The proportions for these two categories are not significantly different from each other.

The results in Figure 4 offer, at best, limited support for the notion that instructions to the respondent influence the ACS response on rent.¹⁸ A substantial majority of telephone interviewees, over 70 percent, report a rent which is at least as close to their TTP as their Contract Rent, as the ACS instructions would have it. However, for personal interviewees, for whom one might expect the interviewer to have the greatest influence on the respondent, the corresponding proportion is only about 60 percent. The same is true for mailback responses, whose proportion reporting an ACS Rent closer to their HUD Contract Rent than their TTP (about 39 percent), does not differ from personal interviewees with statistical significance, despite the instructions in the ACS pamphlet mailed out with the questionnaires, which imply that the HUD subsidy should be included in the response on rent. ACS householders who responded by internet exhibit the highest proportion reporting an ACS Rent closer to their HUD Contract Rent than their TTP (about 50 percent). This seems low since one might expect internet responders, who were able to absorb and follow the instructions for this mode of response, including accessing the internet, to be apt to correctly follow other ACS instructions. In general, Figure 4 seems to lend more support to the alternative view that most householders report their monthly outlay, regardless of any instructions to the contrary.

Education of the (ACS) householder

Education is an individual characteristic measured in the ACS that may well be associated with skills in gathering and understanding information, including information about HUD programs and the housing market in general, as well as interview instructions however conveyed.¹⁹ The proportion of ACS householders coming closer in their reported rent to HUD Contract Rent than TTP are portrayed in

¹⁸ See footnote 2 for a description of the disparity in ACS instructions by mode of interview.

¹⁹ One goal of education is to confer and enhance skills such as literacy that are apt to be beneficial to living in contemporary US society. Such skills are apt to be helpful in securing satisfactory housing through HUD programs in particular.

Figure 5 for our three broad education categories: below high school, high school diploma or equivalent (GED), and beyond high school. The figure suggests that there is a positive correlation between level of education and the proportion of householders reporting ACS Rent closer to HUD Contract Rent than to TTP. Householders with education beyond the high school level, defined as completion of at least one year of schooling at a level beyond high school, register the highest proportion (49 percent), followed by householders with high school education or equivalent (roughly 39 percent) and householders with less than high school education (roughly 30 percent). However, considering that the proportion of householders with education beyond the high school level who report an ACS Rent closer to HUD Contract Rent than to TTP is less than 50 percent,²⁰ this makes for less than compelling evidence that these householders tend to report their HUD Contract Rent in response to the ACS Rent question.

Multivariate Analysis

It seems worthwhile to continue our analysis of the dichotomous variable defined above in a multivariate context, both to eliminate the confounding influence of third variables on bivariate results as well as to explore the effects²¹ of additional variables. A Generalized Linear Model (GLM) with a binomial error and logit link is appropriate when our dichotomy becomes the response variable (McCullagh and Nelder, 1989). The SVYGLM function provided in the Survey package of R enables the model to be fit, computing effects and standard errors consistent with the replicate weight design of the ACS (Lumley, 2014). Our independent variables include those examined above, along with age, sex, and employment status of the householder, household type and income, whether the household's income is sufficient to put it above the poverty line, receipt of public assistance, a variable expressing the

²⁰ The proportion is significantly less than 50 percent.

²¹ The term "effect" is employed here in its technical statistical meaning of association with a difference in the value of the dependent variable in the multivariate analysis, and is not intended to imply causation. Moreover, a "net effect" is simply another term for "regression coefficient" in the present context.

householder's race and Hispanic origin taken together, and a variable measuring the household's English proficiency.

Table 1 presents the results of the "maximal model" that includes all of the independent variables listed above. The dispersion parameter for the model, 1.023, is sufficiently close to the assumed value of 1.0 for a binomial GLM that this assumption can be considered as met. According to the likelihood ratio test, the model fits with high statistical significance ($p < 0.0001$). The Pseudo R-square is an analogue to the R-square measure from ordinary regression (Nagelkerke, 1991), and is adjusted in the R Survey Package for the design effect present in the data from the ACS design (Lumley, 2017). The value of this measure for the maximal model, roughly 0.419, indicates a good fit to the data by the standards for analyses of individual-level survey data.

According to Table 1, most of our independent variables are associated with effect parameters that are significant at the .001 level or better. HUD program category, expressed as a set of 6 differences in effects²² from the Tenant Based Voucher category²³, displays a pattern that is consistent for the most part with the bivariate results in Figure 3. Only Section 236 has a positive effect, indicating that, controlling for the other factors in the model, it is associated with a greater proportion reporting an ACS Rent closer to the HUD Contract Rent relative to the reference category of Tenant Based Vouchers. Section 8 NOS, Housing for the Disabled, and Housing for the Elderly are among the HUD

²² The model contains a constant term, so that our effect terms are akin to those of dummy variables. See Appendix A for a list of the analysis variables and reference categories employed in the multivariate analysis.

²³ In general, we have chosen the category containing the largest number of households as the reference category to which our effects relate.

program categories with the greatest negative effects²⁴, followed by Project Based Vouchers and Enhanced Vouchers.

A noteworthy feature of the multivariate model is that the effect of mode of interview emerges as consistent with what would be expected based on the ACS instructions when the other variables in the model are controlled. Relative to the reference category of mailback response, internet response is positively associated with the proportion²⁵ reporting an ACS Rent closer to HUD Contract Rent than to TTP. Perhaps the most notable result in relation to mode of interview is that in the multivariate model, both personal and telephone interviews are negatively associated with this proportion, as the ACS instructions for the different modes suggest²⁶. This is the first point in the present analysis where both of these modes are in agreement with the ACS instructions for the Rent question for the respective modes of interview during the 2012-2013 period. This pattern may have been obscured by the composition of the mode of interview categories on other variables, such as education, which are being controlled for in the multivariate model.

The net effects of the two education categories in Table 1, representing the influence of education below and above the high school level on reporting an ACS rent closer to Contract Rent than TTP, relative to education at the high school level as the reference category, are fully consistent with the dot chart in Figure 5. Relative to the high school education category, when the other variables in the model are controlled, the below high school education category exhibits a negative net effect, while the

²⁴ The effects for Section 8 NOS and Housing for the Disabled do not differ significantly from each other, while the effects of Housing for the Disabled and Housing for the Elderly are not significantly different from each other either.

²⁵ The effect parameters cannot be interpreted as differences in proportions. However, the dependent variable in the model can be interpreted as representing the proportion reporting a rent closer to Contract Rent than TTP, and the parameters do represent net effects on the logit of that proportion.

²⁶ See footnote 2 for a description of the instructions. It should be noted that these instructions do not appear together in any ACS document for the 2012-2013 period.

category above high school education has a positive net effect. Overall, the level of education as represented by these (three) categories seems to be positively related to the proportion reporting an ACS Rent closer to Contract Rent than TTP when other variables in the model are controlled²⁷.

A number of variables added to the multivariate model emerge with statistically significant effects on the proportion reporting an ACS Rent closer to Contract Rent than to TTP. Households with incomes above the poverty line tend to report incomes closer to Contract Rent than TTP net of other variables in the model. Being male has a highly significant positive effect ($p < 0.0001$). Net of all the other effects in the model, male householders tend to be more apt than female householders to report rent in the ACS that is closer to HUD Contract Rent than to TTP.

Limited English Proficiency, defined as a situation in which no one over age 14 in a household speaks only English or speaks another language but speaks English “very well”, has a negative effect on reporting a rent closer to Contract Rent than to TTP that is highly significant ($p < 0.0001$). A trichotomous household structure variable, with living alone the reference category²⁸ and living with others in either a family or nonfamily setting the other two categories, features a significant positive effect for living in a family household and a considerably higher and also highly significant positive effect ($p < 0.0001$) for living in a nonfamily household with other cohabitants. It may be that this trichotomy is picking up the effect of household size, but the effect parameters seem to indicate that those who live alone tend to report an ACS Rent closer to their TTP than those who live with others, net of the other variables in the model. The possibility that access to information from other household members

²⁷ It may be tempting to interpret the net effects of the categories as the differences in the respective proportions when the other variables in the model are controlled, but it needs to be kept in mind that a logit link function is employed in the model to relate the independent variables to the dependent variable, so that such an interpretation cannot be made. However, the direction of the effects of the categories relative to the high school category can safely be inferred from the effect parameters.

²⁸ This is the category of the trichotomy comprising the greatest number of households.

enhances awareness of the housing market, the terms of the HUD program the household is supported by, or the details of the rental agreement the household entered into cannot be ruled out. It has been suggested that some nonfamily households exist because it is expedient to “double up” with roommates to share the burden of housing costs²⁹, and this might possibly be the reason for the stronger effect of nonfamily household membership.³⁰ Finally, age, in years, has a highly significant ($p < 0.0001$) negative effect on the proportion reporting an ACS Rent closer to the HUD Contract Rent than the TTP.³¹ One possible explanation of this effect is that HUD has historically been moving in the direction of placing initiative on tenants as opposed to taking responsibility for finding them housing. Older tenants may harken back to the status quo ante, or tend to be in older programs in which they are less compelled to know the Contract Rent, other things being equal; this is another avenue to investigate in future research.

Several variables fail to have statistically significant net effects in Table 1. Receiving public assistance fails to meet the $p < 0.05$ threshold of statistical significance. The employment of the householder, viewed as an indicator of overall engagement in the economy and society, fails to exhibit a significant net effect in the model. Net of the poverty line measure, household income loses significance³². Finally, the Race/Hispanic Origin variable is not significant overall with all four effects

²⁹ Personal comment made to the author by Kathy Short, who reported discussing the phenomenon with representatives of the state of Hawaii. In any case, many examples of “roommate” households exist as a matter of common knowledge.

³⁰ In other words, such “households of convenience”, constituted deliberately to share the rental burden, would be more apt to include members cognizant of the actual rent of the unit than households that arose in some other way. Therefore, householders in doubled up households would be more apt to know the contract rent of the unit.

³¹ The logit transformation of a proportion is monotonic, so that a negative net effect of a factor on the logit of a proportion implies a negative effect on the proportion itself. This does not mean to imply that the numeric impact in the sense of a quantitative difference in the values of the proportion in question is obvious from the net effect of the factor in a binomial logit GLM, because the effect pertains to the logit link function and because there are other independent variables in the model. We hasten to add that the terminology of “effect on” refers merely to the parameter value and does not imply causation.

³² In a version of the model with the poverty line measure removed the effect of income is significant.

taken together,³³ which takes account of the intercorrelation of effects among the levels of this factor,³⁴ nor does any of its individual categories exhibit a significant effect. Rather, the effect of Race/Hispanic Origin appears to operate, at least for the typology employed here, through English Proficiency³⁵.

On the basis of Table 1 and some further statistical tests applied to its constituent parameters, we arrived at the “parsimonious model” presented in Table 2, in which variables not having statistically significant effects are omitted and some categories on other independent variables are combined. This model has nearly the same explanatory power as the maximal model, with a design-adjusted Pseudo R-square of 0.419. It turned out that the effects of personal and telephone interviews did not differ from each other significantly, so they are collapsed together in the parsimonious model. Similarly, the effects of Housing for the Elderly and Housing for the Disabled programs are combined. In general, the effects in the parsimonious model closely resemble those in the maximal model. In the instances of collapsed categories, the combined effects bear a resemblance to both of the uncollapsed effects.

Conclusion

This analysis adds to our knowledge of the factors associated with the proportion of ACS householders who report a rent closer to the HUD Contract Rent than the TTP. In particular, it has revealed that mode of interview, whose effect was not clearly evident in previous research, had a

³³ The typology employed was Nonhispanic White Only, Nonhispanic Black Only, Nonhispanic Asian Only, Hispanic of any race, and all others. The latter category encompasses all Nonhispanics in the following racial categories: Native Americans and Alaska Natives, Native Hawaiians and other Pacific Islanders, and any combination of two or more of the 5 available categories.

³⁴ It is possible for standard errors of effect parameters for levels of the same factor to be inflated by multicollinearity, so that no level registers a significant net effect due to inflation of standard errors, while the factor actually has a significant effect.

³⁵ This involves some substantive reasoning as to what other variables in the model might be capturing the effect of Race/Hispanicity. Limited English Proficiency seemed like the most obvious candidate. In any case, when this variable is removed from the model, the effects of some Race/Hispanic categories become significant.

significant association with the proportion in question in both a bivariate and multivariate context in the period of observation. Moreover, in the multivariate context with the effects of other influential variables controlled, the net effects of the various interview modes come into alignment with the ACS instructions as to which rent concept the respondent householder should report. The findings with regard to program type and education indicate that better-educated householders and householders in assistance programs requiring more tenant initiative are more apt to report an ACS Rent closer to Contract rent than TTP. Familiarity with the housing market and Contract Rent may also figure in the effects of household type and English proficiency.

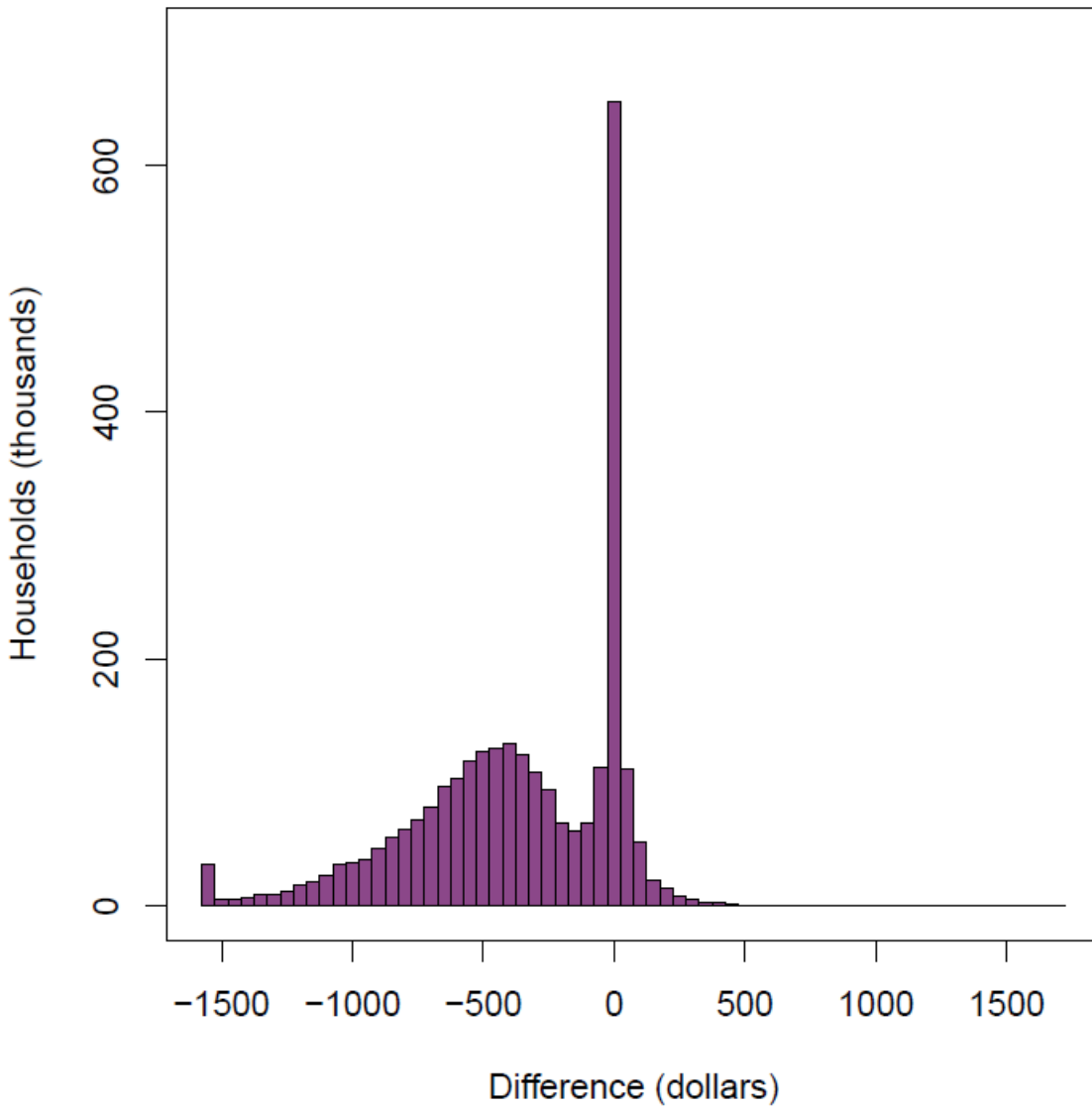
The analysis could be extended by incorporating additional independent variables, such as duration between the ACS interview and the HUD certification, duration of residence in the dwelling unit, household size, and more detailed household composition. It might also be of interest to investigate what results are obtained by the HUD measures of variables such as race and Hispanic origin of the household head.

A promising direction for future effort might be extending the dataset to incorporate additional years. The data are available, and a multi-year dataset would allow for inclusion of a time dimension that could help assess the degree of stability of the effects distinguished, as well as discern evidence of any trends over time in the effects. A larger sample would also make it easier to discern effects of smaller racial groups such as Asians as well as American Indians, and smaller HUD programs such as Moving to Work. Another avenue would be to examine the interaction of individual attributes such as education and age of householder with variables such as HUD program category and mode of interview, which would also be facilitated by a larger sample.

References

- Herzog, Thomas N., Fritz J. Scheuren, and William E. Winkler, Data Quality and Record Linkage Techniques. New York: Springer. 2007.
- Hilbe, Joseph M. and Andrew P. Robinson, Methods of Statistical Model Estimation. Boca Raton: CRC Press. 2013.
- Kingkade, W. Ward, "What are Housing Assistance Support Recipients Reporting as Rent ?", SEHSD Working Paper WP2017-44. Washington, DC: US Census Bureau. 2017.
<https://www.census.gov/library/working-papers/2017/demo/SEHSD-WP2017-44.html>
- Lumley T. "Pseudo-R2 statistics under complex sampling", Australia & New Zealand Journal of Statistics, 59(2), 187-194. 2017.
- Lumley, Thomas, "survey: analysis of complex survey samples". R package version 3.30. 2014.
<http://r-survey.r-forge.r-project.org/survey/>
- Lumley, Thomas, and Alastair Scott, "AIC and BIC for Modeling with Complex Survey Data," Journal of Survey Statistics and Methodology (2015) 3, 1–18.
- McCullagh, Peter, and J. Nelder, Generalized Linear Models (2nd Ed.). London: Chapin and Hall. 1989
- Nagelkerke, N., "A Note on a general definition of the coefficient of determination," Biometrika, 78, 691-692. 1991.
- Renwick, Trudi J, Geographic Adjustments of Supplemental Poverty Measure Thresholds: Using the American Community Survey Five-Year Data on Housing Costs. SEHSD Working Paper Number 2011-21. US Bureau of the Census, July, 2011.
- Renwick, T., & Fox, L. (2016). The Supplemental Poverty Measure: 2015 [U.S. Census Bureau, P60-258(RV)]. Washington, DC: U.S. Government Printing Office.
- Short, Kathleen, The Supplemental Poverty Measure: 2013, Current Population Reports P60-251. US Census Bureau, October, 2014.
- US Department of Housing and Urban Development, Programs of HUD: Major Mortgage, Grant, Assistance, and Regulatory Programs, 2016. portal.hud.gov/hudportal/HUD/hudprograms
- Wagner, Deborah and Mary Layne "The Person Identification Validation System (PVS): Applying the Center for Administrative Records Research and Applications (CARRA) Record Linkage Software". CARRA Working Paper #2014-01. Washington, DC: US Census Bureau. 2014.

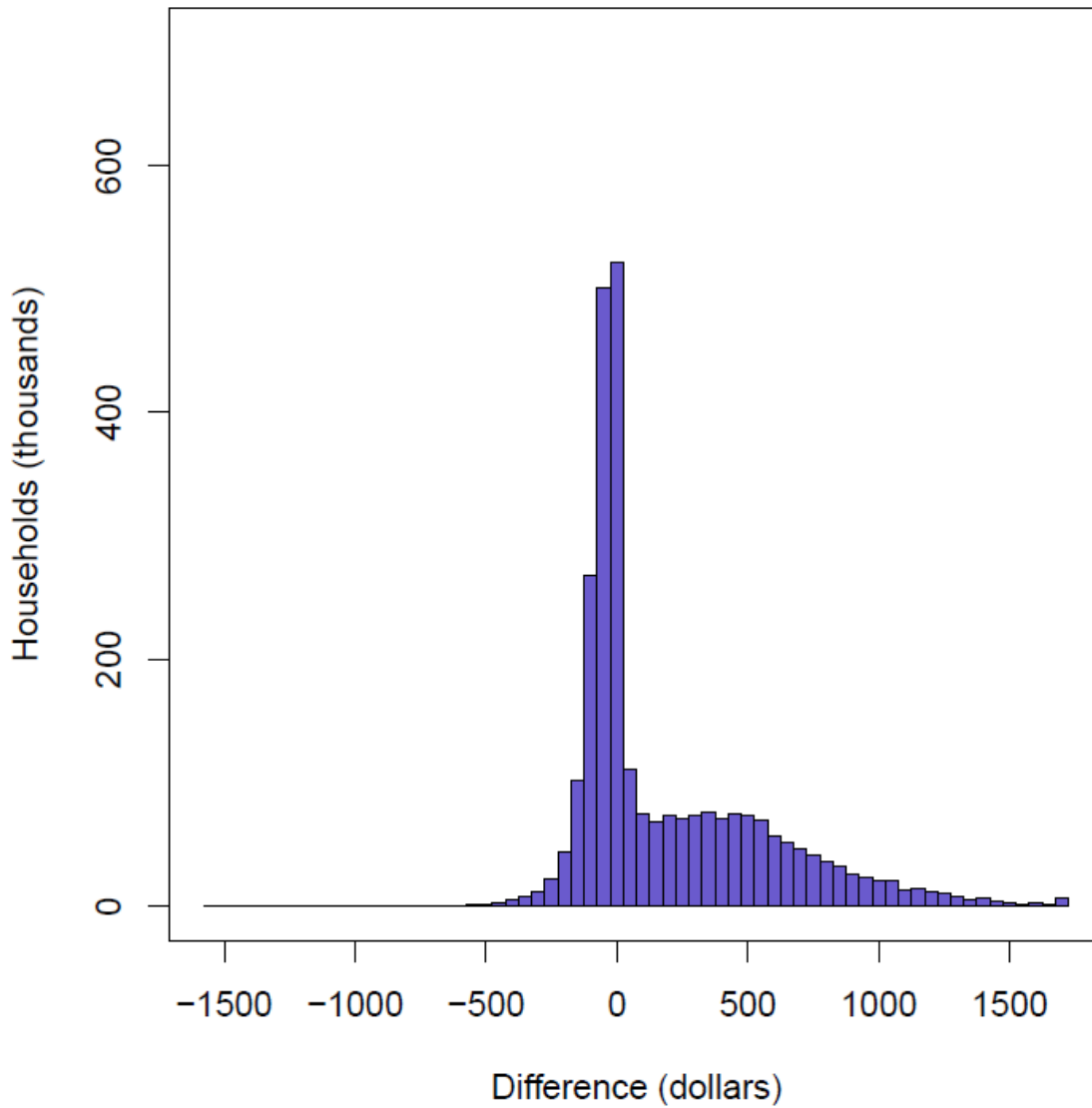
**Figure 1. Difference in Reported Monthly Rent
(ACS Reported Rent – HUD Contract Rent)**



Source: U.S. Bureau of the Census, 2012 and 2013 matched American Community Survey(ACS)/
Department of Housing and Urban Development(HUD) dataset.

Note: For more information on the ACS, see census.gov/acs.

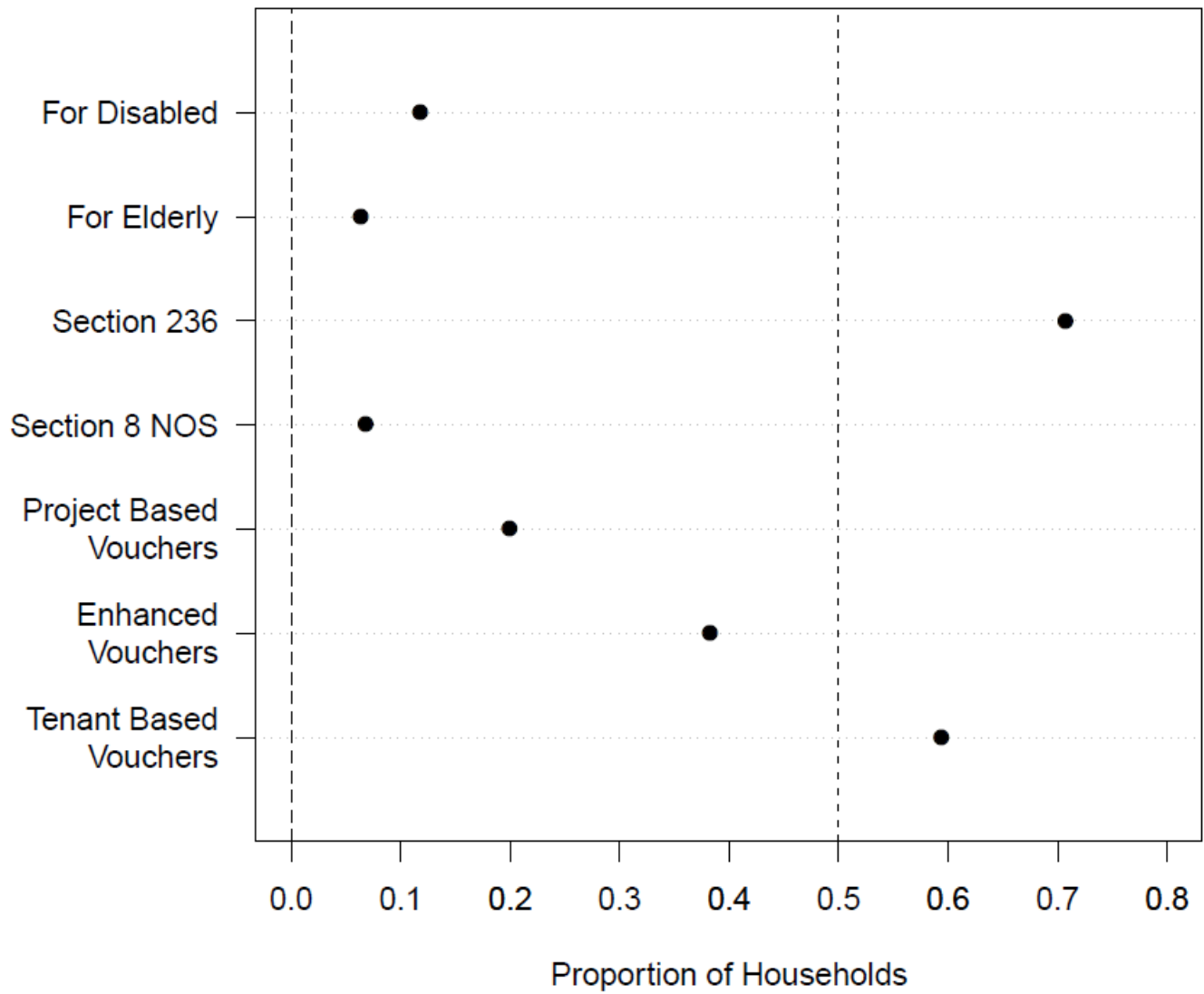
**Figure 2. Difference in Reported Monthly Rent
(ACS Reported Rent – HUD Total Tenant Payment)**



Source: U.S. Bureau of the Census, 2012 and 2013 matched American Community Survey(ACS)/
Department of Housing and Urban Development(HUD) dataset.

Note: For more information on the ACS, see census.gov/acs.

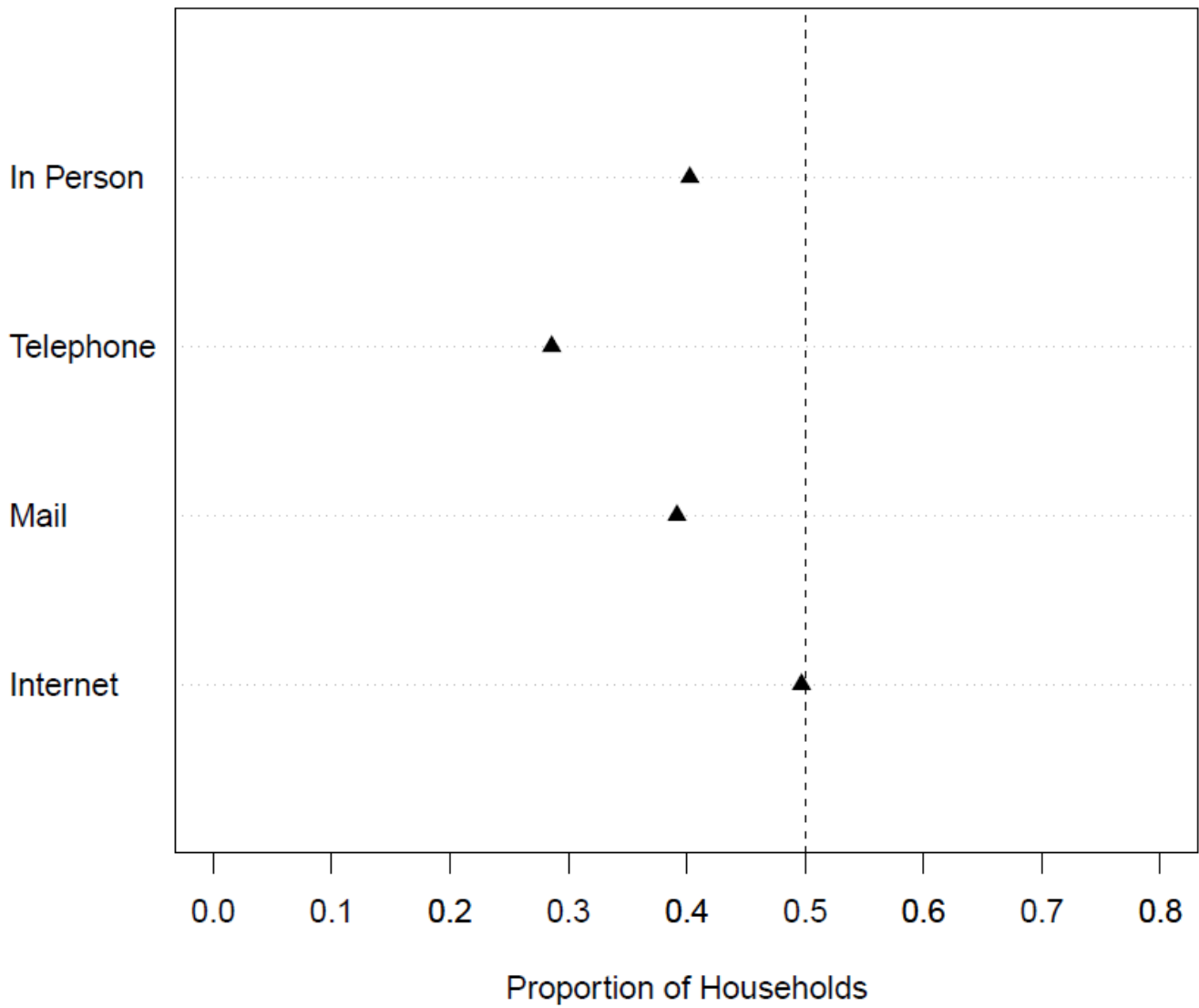
Figure 3. Proportion Reporting ACS Rent closer to HUD Contract Rent than Total Tenant Payment by HUD Program



Source: U.S. Bureau of the Census, 2012 and 2013 matched American Community Survey(ACS)/
Department of Housing and Urban Development(HUD) dataset.

Note: For more information on the ACS, see census.gov/acs.

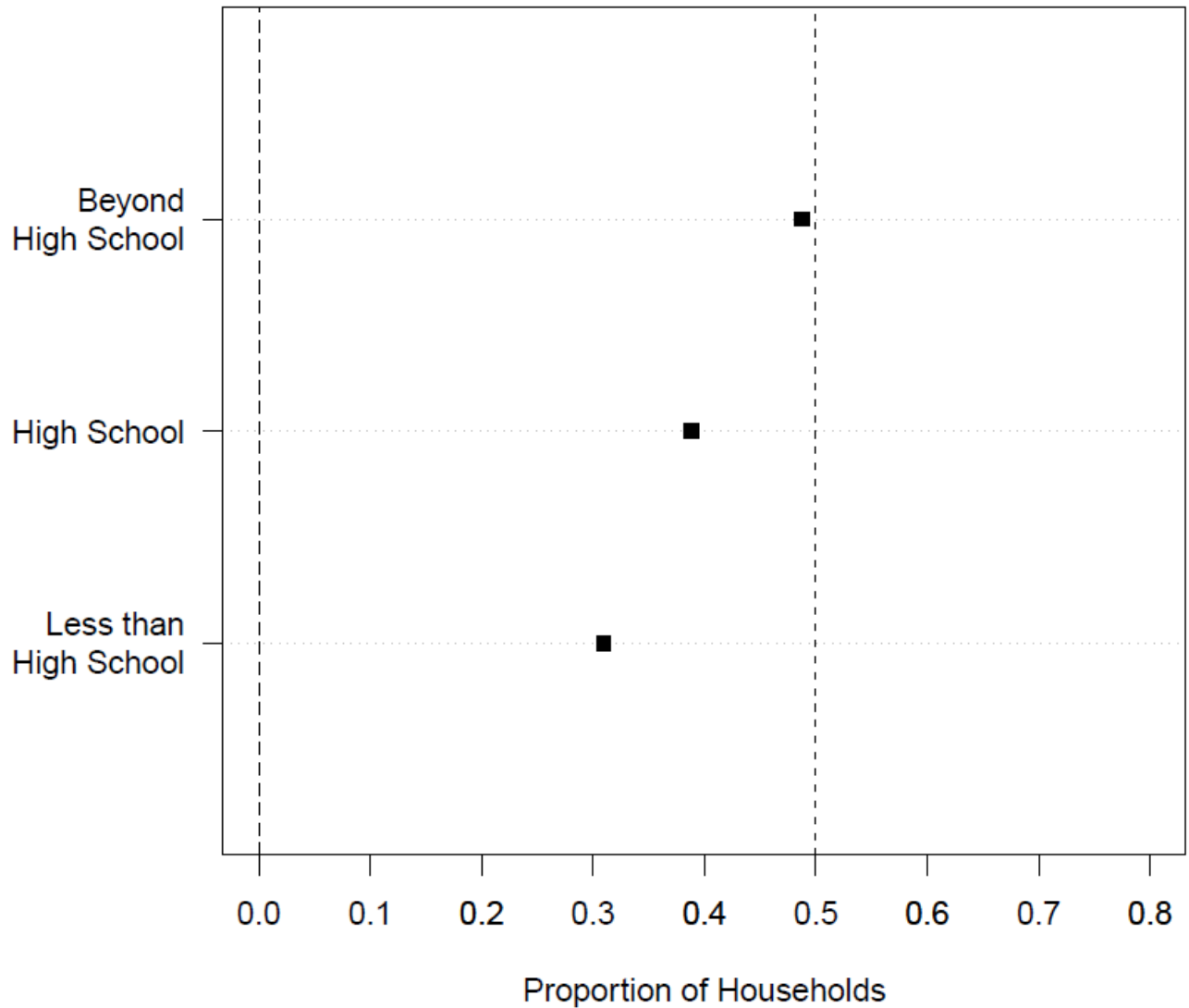
Figure 4. Proportion Reporting ACS Rent Closer to HUD Contract Rent than Total Tenant Payment by Mode of Interview



Source: U.S. Bureau of the Census, 2012 and 2013 matched American Community Survey(ACS)/
Department of Housing and Urban Development(HUD) dataset.

Note: For more information on the ACS, see census.gov/acs.

Figure 5. Proportion Reporting ACS Rent closer to HUD Contract Rent than Total Tenant Payment by Level of Education



Source: U.S. Bureau of the Census, 2012 and 2013 matched American Community Survey(ACS)/
Department of Housing and Urban Development(HUD) dataset.

Note: For more information on the ACS, see census.gov/acs.

Table 1. Maximal Binomial Logit GLM for Closer to ACS Rent vs. TTP Dichotomy.

Variable/Factor Level	Effect	Std. Error	t value	Pr(> t)	Significance
(Constant)	1.594	0.089	18.00	0.0000	***
HUD Pgm Enhanced Vouchers	-0.592	0.147	-4.03	0.0001	***
HUD Pgm Project Based Vouchers	-1.751	0.093	-18.83	0.0000	***
HUD Pgm Section 8 NOS	-2.882	0.048	-59.84	0.0000	***
HUD Pgm Section 236	0.706	0.137	5.14	0.0000	***
HUD Pgm For Elderly	-2.445	0.140	-17.42	0.0000	***
HUD Pgm For Disabled	-2.626	0.233	-11.26	0.0000	***
Interview In Person	-0.605	0.038	-16.10	0.0000	***
Interview by Telephone	-0.695	0.051	-13.72	0.0000	***
Interview Internet	0.183	0.046	4.00	0.0001	***
Above Poverty Line	0.103	0.039	2.64	0.0098	**
On Public Assistance	0.087	0.050	1.73	0.0867	.
Nonhispanic Black Only	0.048	0.042	1.13	0.2600	
Hispanic	-0.008	0.050	-0.15	0.8797	
Nonhispanic Asian Only	-0.139	0.079	-1.75	0.0837	.
Nonhispanic Other Race	-0.073	0.091	-0.80	0.4251	
English Proficiency Limited	-0.348	0.055	-6.33	0.0000	***
Education Less than High School	-0.194	0.043	-4.48	0.0000	***
Education Beyond High School	0.300	0.040	7.57	0.0000	***
Sex of Householder Male	0.176	0.037	4.72	0.0000	***
Family Household w/Others	0.319	0.042	7.50	0.0000	***
Nonfamily Household w/Others	0.674	0.140	4.82	0.0000	***
Age of Householder (years)	-0.023	0.001	-18.83	0.0000	***
Householder Employed	-0.019	0.038	-0.50	0.6190	
Household Income (dollars)	0.000	0.000	0.65	0.5172	
Dispersion	1.023				
Pseudo R ²	0.419				
Likelihood Ratio Test of Model	10190.000			0.0000	***
Significance codes:	‘***’ 0.001	‘**’ 0.01	‘*’ 0.05	‘.’ 0.1	‘ ’ 1

Note: Individual characteristics are those of the householder.

The likelihood ratio tests the joint significance of all variables in the model as a whole.

Source: U.S. Bureau of the Census, 2012 and 2013 matched American Community Survey(ACS)/
Department of Housing and Urban Development(HUD) dataset
For more information on the ACS, see census.gov/acs.

Table 2. Parsimonious Binomial Logit GLM for Closer to ACS Rent vs. TTP Dichotomy.

Variable/Factor Level	Effect	Std. Error	t value	Pr(> t)	Significance
(Constant)	1.644	0.081	20.30	0.0000	***
HUD Pgm Enhanced Vouchers	-0.600	0.147	-4.08	0.0001	***
HUD Pgm Project Based Vouchers	-1.748	0.094	-18.65	0.0000	***
HUD Pgm Section 8 NOS	-2.886	0.047	-60.81	0.0000	***
HUD Pgm Section 236	0.703	0.137	5.15	0.0000	***
HUD Pgm For Elderly/Disabled	-2.492	0.119	-20.98	0.0000	***
Interview Telephone or in Person	-0.615	0.033	-18.57	0.0000	***
Interview Internet	0.177	0.046	3.85	0.0002	***
Above Poverty Line	0.102	0.036	2.83	0.0059	**
English Proficiency Limited	-0.389	0.047	-8.32	0.0000	***
Education Less than High School	-0.193	0.043	-4.46	0.0000	***
Education Beyond High School	0.298	0.039	7.58	0.0000	***
Sex of Householder Male	0.169	0.036	4.70	0.0000	***
Family Household w/Others	0.324	0.041	7.83	0.0000	***
Nonfamily Household w/Others	0.676	0.137	4.93	0.0000	***
Age of Householder (years)	-0.023	0.001	-19.37	0.0000	***
Dispersion	1.024				
Pseudo R ²	0.419				
Likelihood Ratio Test of Model	10330.000			0.0000	***
Significance codes:	‘***’ 0.001	‘**’ 0.01	‘*’ 0.05	‘.’ 0.1	‘ ’ 1

Note: Individual characteristics are those of the householder.

The likelihood ratio tests the joint significance of all variables in the model as a whole.

Source: U.S. Bureau of the Census, 2012 and 2013 matched American Community Survey(ACS)/

Department of Housing and Urban Development(HUD) dataset

For more information on the ACS, see census.gov/acs.

Appendix A. Independent Analysis Variables

HUD Program Category (only those included in analysis). See Appendix B for full detail on HUD programs distinguished in the data.

Enhanced Vouchers

Tenant Based Vouchers (TBVs)*

Also includes, TBVs associated with Moving to Work Program.

Project Based Vouchers (PBVs)

Also includes PIC Certificates and PVBs associated with Moving to Work Program

Section 8 NOS (“Not Otherwise Specified”)

Also includes Welfare to Work, Rent Supplements, and Below Market Interest Rate Program.

Section 236

Also includes Rental Assistance Program

For Elderly

Also includes Housing for Disabled Elderly

For Disabled

Mode of Interview

Mail*

Internet

In Person

Telephone

Poverty Status

Above Poverty Line

Household Income above national poverty line

At or Below Poverty Line*

Household Income at or below national poverty line

Public Assistance Reciprocity

On Public Assistance

Not on Public Assistance*

Race/Hispanic Origin (from 5-category combined PIC/TRACS race variable)

Nonhispanic White Only*

Nonhispanic Black Only

Hispanic

Includes all races alone or in combination

Nonhispanic Asian Only

Nonhispanic Other Race

Includes Native Americans and Alaska Natives, Native Hawaiian and Other Pacific Islanders, and all multiple race combinations.

* - Reference category in multivariate analysis.

Appendix A. Independent Analysis Variables (continued)

English Proficiency

Limited

No one age 14+ in household 1) speaks only English; or 2) speaks another language than English, but speaks English “very well”.

Proficient*

Educational Attainment

Less than High School

Has not received high school diploma or equivalency

High School*

High school diploma or equivalency (e.g. GED), but no further years of schooling.

Beyond High School

Some college credit, even if for less than one year.

Sex

Male

Female*

Household Type

Family Household w/Others

Multiperson household with at least a pair of members related to the householder by kinship or marriage.

Alone*

Single person household.

Nonfamily Household w/Others

Multiperson household, none of whose members are related to the householder by blood or marriage.

Age

Continuous. In single years, since birth.

Employment Status

Emp

Includes persons employed, with a job, including armed forces, whether working in the reference week or not at work. Excludes imputed values.

Not Emp*

Includes persons unemployed or not in the labor force. Excludes imputed values (the latter are excluded from the analysis sample).

Household Income

Continuous. In dollars. Breakeven income coded as zero. Excludes allocated values.

* - Reference category in multivariate analysis.

Appendix B. HUD Program Names and Descriptions

Name	Description
PIC Certificate NOS	Old Program Type Replaced by Project Based Vouchers. Some Units still coded as Certificates. They are said to be really project based vouchers.
Enhanced Voucher	For tenants who would be adversely affected by HUD decisions like terminating project based assistance. Good as long as remain in project. Can cover up to full market rent.
MTW Homeownership Voucher	Homeownership vouchers that are part of Moving to Work program to help residents find employment.
Homeownership Voucher NOS	Public Housing Authority (PHA) can use Housing Choice Vouchers to assist with Mortgage Payments instead of rent, plus down payment assistance. TTP usually 30% monthly adjusted income, 10% of monthly income, or an amount of at least \$25 set by PHA.
PIC Moderate Rehabilitation	Repealed 1991. Assistance limited to properties previously rehabilitated pursuant to housing assistance payments contract with owner and PHA. Expiring contracts are eligible for renewal.
Public Housing	Said to range from single-family units to big high-rises. Financed by HUD and administered by local Housing Authorities. Tenants usually pay 30% of adjusted income, 10% of monthly income, or an amount of at least \$25 set by PHA.
Project Based Voucher NOS	PHAs can assign up to 20% of voucher assistance to specific housing units whose owners agree to rehabilitate or construct units, or set aside a portion of existing units. The PHA pays the owner the difference between 30 percent of family income and the gross rent for the unit.
MTW Project Based Voucher	Project based voucher in Moving to Work Program.
MTW Tenant Based Voucher	Tenant based voucher in Moving to Work Program.
Tenant Based Voucher NOS	Family responsible for finding unit. For low income families. Covers standard 30% adjusted family income or PHA standard or gross rent (whichever is lower).
Welfare to Work Voucher	Type of Section 8 Voucher for families recently on welfare, intended to assist by providing housing nearby work.

Appendix Table B (continued). HUD Program Names and Descriptions

Name	Description
Section 8 NOS	Housing Assistance Payments. Project-based assistance to PHAs or private owners to make rents affordable to tenants.
TRACS Rent Supplement	Rent geared to income with private property owners. Get a unit with rent geared to income. Housing is subsidized. Eligible tenants pay 30 percent of the rent or 30 percent of their income toward the rent, whichever is greater.
RAP	Rental Assistance Payment for Section 236 properties. Extra rent subsidy for very low-income tenants. Predecessor of Section 8.
Section 236	Combines federal mortgage insurance with interest reduction payments to mortgagee to offer housing at below market rents to needy families. No new subsidies. Eligible tenants typically pay 30 percent of the gross rent or 30 percent of the household's adjusted monthly income (whichever is greater) toward the rent, but tenants may pay up to HUD mkt rent. No new subsidies are being offered, but existing properties and tenants continue to be supported
BMIR	Below Mkt Interest Rate subsidized mortgage loans to facilitate construction or rehab of multifamily rental housing for low income families. No new subsidies but grandfather old residents.
Section 202 PRAC	Supportive Assistance for the Elderly. Capital advance to private nonprofit sponsors. Environment should include support services (cleaning, cooking, transportation). Project Rental Assistance Contract. Tenants pay 30% of adjusted income towards rent.
Section 811 PRAC	Supportive Housing for Disabled. Capital advances or providing project rental assistance to state housing agencies. Project Rental Assistance Contract. Tenants live independently but in an environment that provides support activities such as cleaning, cooking, transportation, etc. Occupancy is open to very low-income persons with at least one adult household member with a disability. Rent is highest of 30% of the family's monthly adjusted income, 10% of the family's monthly income, or the welfare rent
Section 202/162 PRAC	Supportive Housing for Elderly Persons with Disabilities. Project Rental Assistance Contract. Rent similar to Section 811 PRAC