Valuing Housing Subsidies in a New Measure of Poverty Using the Current Population Survey

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The official definition of poverty dates back more than 30 years to the early 1960's. There is general agreement that the underlying concepts of the current measure do not adequately reflect reality any longer. The Committee on National Statistics of the National Research Council investigated the underlying concepts and measurement methods in depth. This led to the release of a report containing a set of recommendations about envisioned changes to the current poverty definition. Proposed changes focused on three major areas: the poverty thresholds, the measurement of resources, and data sources.

The panel recommended a resource measure that represents disposable money and near-money resources. This paper deals with the measurement of a specific type of resource, the monetary benefit arising from living in public or subsidized housing. We will examine various methods of accounting for housing subsidies in a new measure of poverty using data from the 1993, and 1995 Current Population Survey (CPS).

The Census Bureau currently estimates housing subsidies in the Current Population Survey to provide an estimate of the subsidy effect on poverty. We will begin by laying out the current model. We will then explore alternatives to this measure. Alternatives include various methods of determining the recipiency unit and of simulating subsidy amounts. In all cases we compute poverty estimates to examine the effect on the poverty rates of various groups of persons using these methods. Mean and aggregate subsidy amounts are compared for the purpose of selecting the 'best' method.

METHODS

We will look at the following five methods of calculating housing subsidies:

Current Method, 1985 American Housing Survey (AHS) - This method employs the current method of calculating subsidy amounts based on data from the 1985 AHS that is updated using a rent index, and matching them to families in the CPS.

Current Method, 1993 AHS - This method is identical to the previous one ("Current Method, 1985 AHS") except it is based on data from the 1993 AHS.

Household Method #2a - This method employs a new model of market rents and uses AHS regression coefficients to impute household subsidy amounts instead of a region/income matrix. It also uses the updated method of calculating the number of bedrooms and 21 geographic areas rather than the four regions.

Household Method #2b - Same as Method #2a above except there are 52 instead of 21 geographic areas.

Fair Market Rents (FMR) **-** The last method uses the FMRs and income rather than a regression method to value housing subsidies.

THE CURRENT CENSUS MEASURE

The Census Bureau has been valuing housing subsidies since 1979. Poverty estimates which take account of housing subsidies in measuring resources have been published annually using the Current Population Survey. This method has four basic steps:

1) Model market rents,
2) Calculate subsidy amounts,
3) Calculate the subsidy values table,
4) Match subsidy amount to each family.

The current method is based on a model of market rents that is estimated using the 1985 American Housing Survey. The market rents that are predicted from this model are used to compute subsidy amounts based on income and regional categories and then matched to families on the CPS according to the number of bedrooms a family could have based, on family size and composition.

1.) Modeling Market Rents

The current method[1] uses the 1985 AHS and employs a model which estimates monthly housing costs for 2 bedroom units of nonsubsidized renters as a function of four indicators. Monthly housing cost, the dependent variable, includes both rent and utility costs. The four independent variables are:

- full baths (half baths ignored) (dummy variable in which 1 means 2 or more baths),
- presence or absence of three kitchen appliances: refrigerator, dishwasher and garbage disposal (dummy variable in which all must be present to have a code of 1, absence of any one of these appliances results in a code of 0),

- presence of any of four problems: hole(s) in wall(s), hole(s) in floor, peeling paint, rats, (dummy variable in which presence of any one of these yields a code of 1 and absence of all yields a code of 0),
- index of satisfaction with community services: police, hospital, public transportation, and shopping, (a response of yes or don't know for each of these services adds 1 to the index)[2].

Separate regressions are run for each of four regions, Northeast, Midwest, South, and West. The regression coefficients are then applied to the housing characteristics of subsidized renters in the relevant region yielding market values of housing costs for subsidized units.[3] [4]

2.) Calculating subsidy amounts

Using the results of the latter regression, we compute the average predicted monthly cost; using the renters' report of how much they pay, we compute their out-of-pocket average monthly cost. The difference between these two means is the estimated average subsidy amount for 2 bedroom units, the most prevalent type of rental unit.

3.) Creating the subsidy values table.

The four region-specific subsidy amounts are used to create a 36 cell matrix. Adjustments are made for family income and for number of bedrooms. For family income, renters are divided into three income categories: less than $6,000, $6,000 to $9,999 and $10,000 or more. The income categories and their adjustment factors are:

Family Income	Adjustment Factor
less than $6,000	1.25
$6,000-9,999	1.15
$10,000 or more	0.48

The second adjustment was for the number of bedrooms, specifically fewer than two and more than two bedrooms. The adjustment factors for bedrooms appear to be two region-specific ratios of the target number of bedrooms to 2 bedrooms using the most recent decennial census data[5]. The numerators of the two ratios are the median gross rent of 1) one bedroom and 2) three bedrooms; the denominator of the ratios is the median gross rent of 2 bedroom units.

After making these adjustments for number of bedrooms and income, we have a 3 by 3 by 4 matrix (viz. income by number of bedrooms by region).

3.) Matching subsidy amounts to families

The next step in imputing a subsidy amount is to match the appropriate subsidy to each family. In order to determine a subsidy amount for which a family is eligible, we computed the number of bedrooms a family qualifies for based on its size and composition. Our current method imputes the number of bedrooms based on the composition of the primary family and related subfamilies. The following steps describe this method.

- select the primary family and related subfamilies from the household. Unrelated subfamilies are assigned one bedroom, regardless of family size.
- The head of the primary family is assigned one bedroom, to be shared with a potential spouse.
- One bedroom is assigned for every two children under the age of six.
- One bedroom is assigned for every two persons over the age of six of the same sex.
- If there is only one child under the age of six, the child shares a bedroom with any same sex person over six.
- If there is an odd number of children under the age of six (and more than one), the extra child is assigned own bedroom.
- If there is an odd number of persons over the age of six, the extra person is assigned own bedroom.
- A primary individual is assigned own bedroom.
- Secondary individuals are assigned zero bedrooms.

Based on the imputed number of bedrooms, family income, and region, the family's housing subsidy is assigned from the subsidy matrix described above.

In subsequent years, adjustment was made for changes in rental costs over time. Subsidies were updated to reflect changes in the cost of rental housing using the Bureau of Labor Statistics' Consumer Price Index (CPI) residential rent index. The ratio is the CPI residential rent index for the target year divided by the corresponding index for the base year.

$$\frac{\text{CPI residential rent}^{(6)}\ \text{index}_{\text{time2}}}{\text{CPI residential rent index}_{\text{time1}}} * \text{subsidy}_{\text{time 1}} = \text{subsidy}_{\text{time 2}}$$

CRITIQUES OF CURRENT METHOD

The currently used method may be criticized on a number of grounds. First, it uses data collected in 1985. Second, the model relies on a few dummy variables and subjective measures (e.g. satisfaction). Third, it ostensibly undervalues housing subsidies because the estimate of expenditures is substantially less than the Department of Housing and Urban Development's (HUD) budget.

In addition, there are a number of criticisms directed at the imputation of bedrooms. First, it probably overestimates the allowable number of bedrooms. One alternative is allowing one person in the household to use the living room as their sleeping quarters. A family can thus choose to either move into a currently available unit with one person sleeping in the living room, or to wait for a unit with an extra bedroom to become available. Second, the number of bedrooms should be a function of household composition as opposed to family composition. The assignment of one bedroom to each unrelated subfamily, regardless of size, does not reflect reality. Since the official poverty measure is family based, the Census Bureau's bedroom routine is also family based to facilitate measuring the impact of housing benefits on poverty.

Third, the Census Bureau routine does not assign all married couples their own room. Married couples in unrelated subfamilies, for instance, had to share their bedroom with any number of potential children. Likewise, married couples in related subfamilies were not assigned their own bedroom, but were treated like any other family members of different sex.

Other factors may affect the number of bedrooms that the subsidized renter with a given household composition occupies. Families and households may be constrained by availability. The modal number of bedrooms in rental housing is two. As the number of bedrooms needed increases, it becomes more difficult to find existing rental housing. Little is known about accommodations that subsidized families make because of the subsidized housing that is available.

A second factor is doubling up. With limited income, families may decide to double up for a variety of reasons. The subsidy may be allotted to one family in a unit occupied by that family as well as other families or individuals. The prevalence of doubling up among subsidized families is not known.

To address the issue of using 1985 AHS data, we update the current model using the 1993 AHS to estimate market rents. We use the current model and method of estimating subsidies. The only difference is the use of more recent data.

We address the issues of model adequacy, by developing both a new model and method. Details of the new method and model follow this section.

The following measures try to correct the first three bedroom imputation problems. The method is a variation of one that currently is used by the Urban Institute. It arrives at the number of bedrooms based on the household composition rather than the family composition. Household housing benefits are prorated to arrive at family benefits essential for poverty estimation. The following steps characterize this procedure.

Imputation of the number of bedrooms

- The householder is assigned one room, to be shared with a potential spouse.
- Each married couple in the household is assigned their own room.
- The number of bedrooms is estimated conservatively in that an "extra" person is not assigned a bedroom but rather is assumed to sleep in the living room. At most, one person can sleep in the living room. For instance, if there is one "extra" male and one "extra" female over the age of six, one of the two can sleep in the living room and the other is assigned a bedroom.

The number of bedrooms translates into household subsidy amounts depending on region and household income (CPS method). Household subsidy amounts, in turn, translate into family subsidy amounts by prorating by the number of persons in the family relative to the number of persons in the household.

HOUSEHOLD MODEL AND METHODS 2A AND 2B: A NEW APPROACH TO MODELING HOUSING SUBSIDIES

1.) Modeling market rents

The new model is based primarily on the characteristics of the rental unit and its amenities rather than primarily with problems and satisfaction. Most research shows that people are relatively satisfied with their housing, suggesting that satisfaction is reported on a relative basis rather than some absolute scale. In the real estate community, housing generally is priced on the basis of physical characteristics and amenities, as well as location.

The new model includes a broader range of explanatory variables than does the current model, and many of the variables are continuous, rather than dichotomous. Listed in Table 1 in the Appendix, the variables in the new model include nine housing unit characteristics, utility costs, length of residence, family income, and a large set of geographic indicators. Number of bedrooms and income are entered explicitly into the equation, as well as a variable representing income squared, presuming a nonlinear relationship between monthly cost and income.

The National Research Council recommended that housing subsidies should reflect the variation in housing costs that occur across the United States[7]. Responding to this concern, we developed geographic indicators

that attempt to define housing markets in a much more precise way than the region indicators used in the current methods. At the same time, these geographic constructs take into account the constraints of samples: areas contained in one sample may not exist in other samples.
We actually use two variations of this models The housing and household characteristics are the same in both variations, but the geographic indicators are expanded in one. In the simpler one there are 17 metropolitan categories that capture different housing markets based on metropolitan size; in the more detailed model there are 48 metropolitan categories. The geographic indicators classify markets by the size of the Consolidated Metropolitan Statistical Area (CMSA) and the Primary Metropolitan Statistical Area (PMSA). The size categories are:

CMSA Population Size	PMSA Population Size
< 100,000	< 100,000
100,000 - 249,999	100,000 - 249,999
250,000 - 499,999	250,000 - 999,999
500,000 - 999,999	1,000,000 or more
1,000,000 - 2,499,999	
2,500,000 - 4,999,999	
5,000,000 - 9,999,999	
10,000,000 or more	

There are 17 combinations of CMSA by PMSA size. The expanded set of 48 subdivides these 17 combinations by region. In addition, both sets have 4 nonmetropolitan housing market variables, one for each region.
Appendix Table 1 shows the estimated coefficients, t-statistics and significance for nonsubsidized renter households. The regression coefficients generally behave as one would expect: additional bedrooms and more amenities increase monthly housing costs[8], and length of residence decreases it. The coefficients for housing amenities generally are significant. The one exception is clothes dryer in the model with 21 housing markets. The coefficients for the geographic variables exhibit the expected diversity with more disparity noticeable in the model with the more detailed 52 housing markets. In this model, the coefficients for geographic variables range from $-101 to $570 for smaller PMSA's in New York City. The R-square on these estimated models is quite high: .53 and .56.
2.) Household Methods 2a and 2b
Our new model is similar to the current model in its first steps. Like the current model, we use multiple regression to model monthly housing costs of nonsubsidized units and obtain regression coefficients for each of the housing, financial, and geographic indicators. However, the regression equation includes all nonsubsidized units rather than region-specific two bedroom units. Applying these coefficients to the characteristics of subsidized housing units, we obtain predicted market rents. Up to this point the new method is very similar to the current one except that:
1) the model variables are different,
2) only one regression is used, instead of 4, and
3) the regressions include all units, instead of only 2 bedroom units.
From this point, however, the new household method differs from the current method. Instead of calculating subsidy amounts as the difference in average market values and average actual costs, we now compute a subsidy at the household level by subtracting the householder's reported out of pocket costs from the predicted market value of the unit.[9]
Taking this one step further, we use the calculated subsidy amount to model subsidies in the AHS. We model subsidies by regressing the subsidy amount on the number of bedrooms for which the family is eligible, family income and income squared, and the geographic indicators for 'housing markets'.[10]
Results from this estimation are reported in appendix Tables 2a and 2b. Again the regression coefficients have the expected signs. Showing substantial variation for geographic variables the coefficients for subsidies range from $-85 to $497 in the model with more geographic detail.
Since all of the variables in the regression for the subsidy model are available in the CPS, we next apply this model to subsidized CPS households in order to estimate the amounts of their subsidies. Table 3 shows the mean values of these estimates from the 1993 AHS. For units indicated as subsidized, we predict an average of $477 per month market rent. On average, renters of these units report paying $259 per month. We calculate that the average subsidy amount is $230 per month.

Table 3
Reported monthly cost, predicted monthly cost, and estimated subsidy amounts: mean values

monthly cost	$259
predicted monthly cost	477
subsidy	230

In addition to these regression models we use Fair Market Rents directly to value housing subsidies. The Department of Housing and Urban Development develops FMRs annually in order to determine rental subsidies for eligible households in 341 metropolitan areas and in 2,416 counties outside metropolitan areas. FMRs are set at the 45th percentile[11] of the rent distribution of two-bedroom apartments in a given area. Section 8 renters pay 30 percent of their net countable income towards rent and utilities, an amount that generally cannot exceed the Fair Market Rent for this area. The balance is the subsidy amount.

Since the relevant geographic identifiers are available in CPS, we are able to match the HUD Fair Market Rents to our 1993 CPS file. We took the following steps to adapt Fair Market Rents for our purpose of estimating subsidy amounts in CPS and the effect on poverty.

- Impute the number of bedrooms as delineated in the household method below.
- Estimate the household subsidy by subtracting 30% of household income from the Fair Market Rent .
- Adjust the household subsidy for relative family size to arrive at the family subsidy.

Fair Market Rents are generally considered to be ill-suited to this application because they are often set quite high. It is believed that FMRs are often higher than the going market rent for a particular unit. In some cases, rents may be set higher in order to motivate landlords to participate in the program; in project based units, higher rents may reflect development costs rather than market rents. Thus, we expect subsidy amounts calculated based on these amounts to be higher than those based on other methods. Our expectation is that these estimates will represent an upper bound on our valuation of housing subsidies.

In addition to some problems with FMRs in general, there is a drawback of using FMRs in the way outlined above. Since we do not collect information on rent subsidies or rent paid in the CPS we cannot calculate the actual subsidy amount as the difference between rent paid and 30 percent of net countable income. Instead, we estimate the subsidy as the difference between the Fair Market Rent and 30 percent of net countable income. This procedure overestimates subsidy amounts. The size of the bias is not known, since we do not have information on the difference between Fair Market Rents and actual rent paid by residents in subsidized housing.

RESULTS

This paper presents the results of these three methods of valuing housing subsidies . The methods are used to impute subsidy values in the CPS. We calculate various statistics by which we compare the methods. We examine aggregate subsidy amounts from the methods to compare to HUD expenditures on housing programs which serve as a benchmark .[12] We look at average monthly subsidies as calculated by each method. And finally we look at the effect on poverty rates using the different methods and the incidence of poverty on various population subgroups. The three methods and their variations that we examine are:

- Original Method - This method employs the current method of calculating subsidy amounts. We use two AHS data sets:

  a) 1985 data updated with the CPI residential rent index ratio, which is used in current reports, and
  b) the more recent 1993 data

- Household Methodology #2[13] - This method differs from the original method in two ways. First, it matches subsidy amounts to families using the updated method of calculating the number of bedrooms for which a household is eligible. Second, we now use two sets of AHS regression coefficients and impute household subsidy amounts at the household level instead of a region/income matrix. We use two models that differ only in their geographic detail:

  a) regression with 17 metropolitan and 4 nonmetropolitan housing markets, (household method 2a),
  b) regression with 48 metropolitan and 4 nonmetropolitan housing markets, (household method 2b).

- Fair Market Rents **-** The last method uses the FMRs to value housing subsidies rather than either the current method or the regression methods described above.

AGGREGATE EXPENDITURE

As seen in Table 4, aggregate expenditures on housing subsidies vary greatly by estimation method. Using the original method and the original (viz. 1985) data updated with the CPI for residential rent, yields an aggregate expenditure of $10.7 billion in 1993. Updating the data source on which the subsidies are based has a dramatic effect on aggregate expenditure; it increases to $16.7 billion.. The FMR method gives an estimate of $16.6 billion which is similar to that obtained using 1993 data. Aggregates for the new household models are intermediate at $12.2 and $12.5 billion.

Aggregates computed for 1995 using the original method and the FMRs are similar to 1993 aggregates. The estimates of aggregate expenditure using the original method with 1993 data and using the FMRs compare more favorably with expenditures. For example, in 1993 HUD budgeted $16.5 billion dollars for rental assistance which is close to the original method using recent data and to the FMR approach.[14]

TABLE 4
Aggregate Expenditure (Billions)

	1993	**1995**
Current method, 1985 data	10.7	10.1
Current method, 1993 data	16.7	15.7
Household Method #2a	12.2	12.7
Household Method #2b	12.5	12.0
FMR Method	16.6	15.6

MEAN SUBSIDY LEVELS.

Table 5 shows the average monthly subsidies of families (not persons or households) who received subsidies for one or more months during 1993, and 1995 for each of the methods.[15] . For both 1993 and 1995, the current method using CPI residential rent ratios for adjustment again has the lowest average subsidy while the highest means are for the same model using 1993 data and FMRs. The new regression models yield intermediate average housing subsidies of between $181 and $201.

TABLE 5
Average Monthly Subsidies: 1993, 1995 (in dollars)

	1993	**1995**
Current method, 1985 data with CPI ratio update	160	161
Current method, 1993 data	249	249
Household Method #2a	181	201
Household Method #2b	186	191
FMR Method	247	248

EFFECTS ON POVERTY

Adding housing subsidies to income reduces the official poverty rate. As shown in Table 6, using the existing method (1985 data updated by relevant CPI index) to value housing subsidies reduces the poverty rate from 15.1 to 14.7 in 1993, and lifts 1.25 million people out of poverty. Using 1993 AHS data with the existing method lowers the poverty rate another 0.3 percentage points from 14.7 to 14.4 and lifts a total of 2.04 million people out of poverty. Thus, merely updating the data source for housing subsidies from the 1985 AHS to the 1993 AHS moves an additional 0.79 million people out of poverty. Using FMR to value subsidies reduces the poverty rate to 14.3 percent, rather than the base rate of 15.1 percent and almost 3 million people would move out of poverty as a result of adding housing subsidies to income. Using either of the two new models, reduces the poverty rate to 14.6 percent.

Similar results occur in 1995 for the poverty rate. The percentage point difference in poverty rates are similar. For example, the decline in poverty rates from the base poverty rate and using the current subsidy model is .4 percentage points in 1993 and .5 percentage points in 1995.

TABLE 6
The Effect of Housing Subsidies on Poverty: 1993, 1995

	1993			1995		
Numbers in 1,000	**No. Poor**	**Rate**	**Marg. Eff No. Poor**	**No.Poor**	**Rate**	**Marg. Eff No. Poor**
Base Poverty	39,265	15.1		36,425	13.8	
Current Method: CPI updated 1985	38,015	14.7	1,250	35,180	13.3	1,245
Current Method: 1993 AHS data	37,222	14.4	2,043	34,446	13.1	1,979
Household Method #2a	37,919	14.6	1,346	34,859	13.2	1,566
Household Method #2b	37,922	14.6	1,343	34,867	13.2	1,558
FMR Method	36,985	14.3	2,966	34,182	13.0	2,243

Table 7 shows that adding housing subsidies to income has an uneven effect on reducing the poverty rates of various demographic groups. Furthermore, the method of estimating subsidies affects the magnitude of the reduction. For example, in 1993, using the existing method with index-updated 1985 data reduces the poverty rate of the elderly to 10.7 percent from the base rate of 12.2 percent, a reduction of 14 percent. Substantial reductions in the poverty rate of elderly persons occur for each method, resulting in poverty rates between 10.3 (FMR) to 10.8 percent (both new models). Adding housing subsidies to income has a smaller impact on the poverty rates for children. Using the existing model decreases the poverty rate from 22.7 to 22.4 percent, a reduction of only 1 percent from the base rate. For other models, poverty rates for children are reduced by 5 percent at most (to 21.7 for the FMR model).
Differential effects are evident also for other demographic groups. In general, those most affected are the elderly, women, people in families headed by a woman, and residents of the.

TABLE 7a
The Effect of Housing Subsidies on Poverty Rates, by Characteristics, 1993

	Base Poverty Rate	**Current Method: 1985 Data**	**Current Method: 1993 Data**	**Household Method 2a**	**Household Method 2b**	**FMR Subsidy**
AGE						
Kid	22.7	22.4	22.0	22.2	22.2	21.7
Adult	12.4	12.1	11.8	12.1	12.1	11.8
Elderly	12.2	10.7	10.4	10.8	10.8	10.3
SEX						
Male	13.3	13.1	12.9	13.0	13.0	12.8
Female	16.9	16.2	15.8	16.2	16.2	15.7
REGION						

Northeast	13.3	12.5	12.2	12.4	12.4	11.7
Midwest	13.4	13.0	12.6	12.9	13.0	12.6
South	17.2	16.7	16.4	16.7	16.7	16.5
West	15.6	15.3	15.0	15.2	15.2	14.8
FAMILY TYPE						
Married Couple	8.0	7.9	7.9	7.9	7.9	7.9
Male Householder	17.6	17.0	16.8	17.0	17.1	16.9
Female Householder	38.7	37.5	36.2	37.2	37.1	35.6

TABLE 7b
The Effect of Housing Subsidies on Poverty Rate, by Characteristics, 1995

	Base Poverty Rate	**Current Method: 1985 Data**	**Current Method: 1993 Data**	**Household Method 2a**	**Household Method 2b**	**FMR Subsidy**
AGE						
Kid	20.8	20.4	20.0	20.1	20.1	19.6
Adult	11.4	11.0	10.8	11.0	11.0	10.8
Elderly	10.5	9.4	9.1	9.4	9.5	9.2
SEX						
Male	12.2	11.8	11.7	11.8	11.8	11.6
Female	15.4	14.8	14.4	14.6	14.7	14.3
REGION						
Northeast	12.5	11.6	11.3	11.5	11.5	10.8
Midwest	11.0	10.7	10.4	10.6	10.6	10.6
South	15.7	15.3	15.1	15.2	15.3	15.2
West	14.9	14.5	14.2	14.5	14.4	13.9
FAMILY TYPE						
Married Couple	6.8	6.7	6.7	6.7	6.7	6.6
Male Householder	14.9	14.6	14.2	14.3	14.3	13.9
Female Householder	36.5	35.2	34.2	34.5	34.6	33.5

Northeast region. These differential effects may be due to differences in family composition or geographic differences in rents as captured by the different methods of valuing housing subsidies.

MOVEMENTS OUT OF POVERTY AND HOUSING SUBSIDIES AMONG THE POOR

In 1993, about 3.2 percent of the poor (under the official definition) become non-poor when housing subsidies (valued by the existing method with index-updated 1985 data) are added to income. When updated data (1993) are used to estimate housing subsidies, 5.2 percent of the official poor become non-poor. Under the FMR scenario, 7.6 percent of the poor become non-poor.

About 19.1 percent of the poor (official measure) receive housing subsidies, whereas only 2.2 percent of the non-poor receive these subsidies. Using updated data to estimate housing subsidies, and adding these subsidies to income when determining poverty reveals that 3.0 percent of the non-poor are subsidized, while 14.6 percent of the poor are. In the FMR scheme, 3.5 percent of the non-poor are subsidized, while 12.5 percent of the poor are. Note that the percentage of poor receiving housing subsidies decreases as the subsidy amount increases because higher subsidy amounts move people from a poor to a non-poor status.

CONCLUSION

It is intuitively obvious that adding near-cash equivalents to cash income reduces the poverty rate. Housing subsidies are no exception. Revising the current valuation of housing subsidies by using a more plausible model generally reduces the poverty rate more than using the current model which uses 1985 data updated with CPI rent indices. This occurs for both 1993 and 1995 income.

On the face of it, the new model has greater appeal on several counts: 1) its specification is more consistent with those factors that the real estate market uses for appraising real estate, 2) it incorporates differences among different housing markets, and 3) it values subsidies at the household level rather than using a more limited 36 cell matrix (i.e. 3 X 3 X 4) for all subsidized units. The model meshes with HUD expenditures and known differences-- that is, it is somewhat below the HUD expenditure and the FMR estimate.

Table 1A
Regression Results for Nonsubsidized Households: 21 Market Areas

Variable Descriptions	Coefficients	T Statistic	
Intercept	84.6901	7.325	****
# bedrooms, max is 6	38.5267	15.396	****
numeric: inc11. Family income	0.0029	29.59	****
income squared	-3.352E-9	-21.632	****
# baths, max is 3	122.3762	23.39	****
# half baths, max is 3	47.6050	8.709	****
# of years in residence	-4.5333	-15.181	****
avrg mnthly cst of utlties cst04-cst10	0.7046	22.495	****
dum 1=yes GARBAGE DISPOSAL	33.3193	7.106	****
dum 1=yes DISHWASHER	56.0144	11.223	****
dum 1=yes CLOTHES DRYER	7.0478	1.633	
dum 1=yes CENTRAL AIR CONDITIONING	-8.0926	-1.756	*
dum 1=yes FIREPLACE	52.1302	9.586	****
dum 1=yes CARPORT OR GARAGE	30.4248	7.467	****
urb01=1: Cntrl City of UA	-16.7843	-3.964	****
urb01=3: not UA, urban	-35.6702	-4.82	****
urb01=4: not UA, rural	-73.8238	-10.866	****
dummy: northeast nonmetro	122.3681	7.841	****
dummy: south nonmetro	-36.2830	-3.292	***
dummy: west nonmetro	37.3585	2.79	**
1 milln+ (P)MSA, 1mill-2,499,999 (C)MSA	90.4243	8.623	****

1MIL+ (P)MSA, 2.5 - 5MIL (C)MSA	139.5625	12.639	****
1 milln+ (P)MSA, 5mill-9,999,999 (C)MSA	270.0963	23.067	****
1 milln+ (P)MSA, 10mill or more (C)MSA	291.8489	26.742	****
250K-999,999 (P)MSA, 250K-499,999 (C)MSA	47.4444	4.238	****
250K-999,999 (P)MSA, 500K-999,999 (C)MSA	55.7185	5.135	****
250K-999,999 (P)MSA, 1-2.5MIL (C)MSA	145.8108	7.801	****
250K-999,999 (P)MSA, 2.5-5 MIL (C)MSA	131.1709	4.722	****
250K-999,999 (P)MSA, 5-10 MIL (C)MSA	174.0482	9.365	****
250K-999,999 (P)MSA, 10MIL + (C)MSA	302.7420	16.396	****
100-249K (P)MSA, 100K-249,999 (C)MSA	17.1607	1.549	
100-249K (P)MSA, 1 mill-2,499,999 (C)MSA	92.7849	4.034	****
100-249K (P)MSA, 2.5 - 5MIL (C)MSA	96.4303	3.669	***
100-249K (P)MSA, 5 mill-9,999,999 (C)MSA	302.9106	8.085	****
100-249K (P)MSA,10Milln or more (C)MSA	565.8862	11.907	****
<100K (P)MSA, < 100K (C)MSA	7.5209	0.329	
<100K (P)MSA, 1 mill-2,499,999 (C)MSA	177.0244	2.275	*
Suppressed: Midwest nonmetro.	* Sig at .0101 to .1000		
Adj. R square .5274	** Sig at .0011 to .0100		
	*** Sig at .0002 to .0010		
	**** Sig < = .0001		

Table 1B
Regression Results for Nonsubsidized Households: 52 Market Areas.

Variable Descriptions	Coefficients	T Statistic	
Intercept	79.7689	7.138	****
# bedrooms, max is 6	39.0904	16.195	****
numeric: inc11. Family income	0.0026	27.763	****
income squared	-3.0687E-09	-20.494	****
# baths, max is 3	122.1629	24.1	****
# half baths, max is 3	50.0107	9.485	****
# of years in residence	-4.862026	-16.778	****
avrg mnthly cst of utlties cst04-cst10	0.7695	25.219	****
dum 1=yes GARBAGE DISPOSAL	35.4752	7.409	****
dum 1=yes DISHWASHER	47.7239	9.811	****
dum 1=yes CLOTHES DRYER	10.064957	2.412	*
dum 1=yes CENTRAL AIR CONDITIONING	22.6965	4.799	****
dum 1=yes FIREPLACE	47.0389	8.933	****

dum 1=yes CARPORT OR GARAGE	27.1798	6.503	****
urb01=1: Cntrl City of UA	-16.5876	-4.015	****
urb01=3: not UA, urban	-36.1209	-5.029	****
urb01=4: not UA, rural	-71.8299	-10.927	****
dummy: northeast nonmetro	126.9391	8.448	****
dummy: south nonmetro	-43.2373	-4.07	****
dummy: west nonmetro	39.1481	3.037	**
1 mil+ (P)MSA, 1-2.5mil (C)MSA. in Northeast region	77.6908	4.019	****
1 mil+ (P)MSA, 2.5-5mil (C)MSA. in Northeast region	347.470399	20.815	****
1 mil+ (P)MSA, 5-10 mil (C)MSA. in Northeast region	185.6545	12.02	****
1 mil+ (P)MSA, 10mil+ (C)MSA. in Northeast region	338.3686	29.244	****
250K-1MIL (P)MSA, 250K-500K (C)MSA. in Northeast region	124.4426	6.812	****
250K-1MIL (P)MSA, 500K-1MIL (C)MSA. in Northeast region	130.1982	8.667	****
250K-1MIL (P)MSA, 1-2.5 mil (C)MSA. in Northeast region	217.5232	9.641	****
250K-1MIL (P)MSA, 2.5-5 mil (C)MSA. in Northeast region	256.7743	6.733	****
250K-1MIL (P)MSA, 5-10 mil (C)MSA. in Northeast region	329.2569	7.738	****
250K-1MIL (P)MSA, 10 mil+ (C)MSA. in Northeast region	300.5974	15.766	****
100-249K (P)MSA, 100K-250k (C)MSA. in Northeast region	124.0060	5.481	****
100-249K (P)MSA, 1- 2.5ML (C)MSA. in Northeast region	34.8191	1.098	
100-249K (P)MSA, 2.5-5ML (C)MSA. in Northeast region	211.595297	5.501	****
100-249K (P)MSA, 5-10ML (C)MSA. in Northeast region	214.9285	3.558	***
100-249K (P)MSA, 10ML+ (C)MSA. in Northeast region	569.5168	12.45	****
<100K (P)MSA, < 100K (C)MSA. in Northeast region	152.8871	3.184	**
<100K (P)MSA, 1-2.5 mil (C)MSA. in Northeast region	186.0532	2.484	*
1 mil+ (P)MSA, 1- 2.5ML (C)MSA. in Midwest region	65.4339	5.504	****
1 mil+ (P)MSA, 2.5 to 5ML (C)MSA. in Midwest region	66.9254	4.521	****
1 mil+ (P)MSA, 5 to 10ML (C)MSA. in Midwest region	240.4656	17.286	****
250K-1ML (P)MSA, 250K-500K (C)MSA. in Midwest region	42.5528	2.747	**
250K-1M (P)MSA, 500K-1MIL (C)MSA. in Midwest region	8.7707	0.537	
250K-1ML (P)MSA, 1-2.5 mil (C)MSA. in Midwest region	55.3136	1.391	
250K-1MIL (P)MSA, 2.5-5 mil (C)MSA. in Midwest region	26.1172	0.736	
250K-1MIL (P)MSA, 5-10mil (C)MSA. in Midwest region	120.2258	4.921	****
100-249K (P)MSA, 100K-250k (C)MSA. in Midwest region	0.5644	0.041	
100-249K (P)MSA, 1 TO 2.5mil (C)MSA. in Midwest region	83.2585	1.804	*
<100K (P)MSA, < 100K (C)MSA. in Midwest region	28.2946	0.842	
1 mil+ (P)MSA, 1 to 2.5mil (C)MSA. in South region	65.8799	5.658	****
1 mil+ (P)MSA, 2.5 to 5mil (C)MSA. in South region	109.2154	9.686	****
250K-1MIL (P)MSA, 250K- 500K (C)MSA. in South region	-22.0116	-1.617	
250K-1MIL (P)MSA, 500K-1MIL (C)MSA. in South region	12.3318	1.072	
250K-1MIL (P)MSA, 5 TO 10 mil (C)MSA. in South region	146.4399	2.794	**
100-249K (P)MSA, 100K-250k (C)MSA. in South region	-27.6361	-2.248	*
100-249K (P)MSA, 2.5 TO 5 mil (C)MSA. in South region	11.9776	0.376	
<100K (P)MSA, < 100K (C)MSA. in South region	-58.5810	-1.374	
1 mil+ (P)MSA, 1 to 2.5mil (C)MSA. in West region	121.9381	10.494	****
1 mil+ (P)MSA, 5 to 10 mil (C)MSA. in West region	365.7471	26.377	****

1 miL+ (P)MSA, 10mill+ (C)MSA. in West region	255.6540	22.118	****
250K-1MIL (P)MSA, 250-500K (C)MSA. in West region	89.5884	6.032	****
250K-1MIL (P)MSA, 500K-1MIL (C)MSA. in West region	129.1291	7.829	****
250K-1MIL (P)MSA, 1-2.5mil (C)MSA. in West region	57.1936	1.85	*
250K-1MIL (P)MSA, 5-10mil (C)MSA. in West region	194.5431	6.51	****
250K-1MIL (P)MSA, 10 mil+ (C)MSA. in West region	335.9159	8.823	****
100-249K (P)MSA, 100K-250k (C)MSA. in West region	97.8531	5.507	****
100-249K (P)MSA, 1- 2.5 mil (C)MSA. in West region	189.839102	5.403	****
100-249K (P)MSA, 5- 10 mil (C)MSA. in West region	352.7761	7.989	****
<100K (P)MSA, < 100K (C)MSA. in West region	-101.1362	-2.271	*
Suppressed: Midwest nonmetro.	* Sig at .0101 to .1000		
Adj. R square .5624	** Sig at .0011 to .0100		
	*** Sig at .0002 to .0010		
	**** Sig <= .0001		

Table 2A
Regression Results for Subsidized Households: 21 Market Areas.

Variable Description	Coefficient	T Statistic	
# bedrooms, max is 6	72.8236	15.823	****
numeric: inc11. Family income	-0.0068	-8.908	****
income squared	0.0000000729	5.358	****
dummy: northeast nonmetro	67.2127	3.075	**
dummy: south nonmetro	2.8529	0.174	
dummy: west nonmetro	78.5013	3.056	**
1 milln+ (P)MSA, 1mill-2,499,999 (C)MSA	89.4004	6.648	****
1MIL+ (P)MSA, 2.5 - 5MIL (C)MSA	117.7175	7.419	****
1 milln+ (P)MSA, 5mill-9,999,999 (C)MSA	228.3228	13.969	****
1 milln+ (P)MSA, 10mill or more (C)MSA	166.8012	12.329	****
250K-999,999 (P)MSA, 250K-499,999 (C)MSA	43.6094	2.664	**
250K-999,999 (P)MSA, 500K-999,999 (C)MSA	67.6357	4.603	****
250K-999,999 (P)MSA, 1-2.5MIL (C)MSA	87.404	3.177	**
250K-999,999 (P)MSA, 2.5-5 MIL (C)MSA	126.2372	3.021	**
250K-999,999 (P)MSA, 5-10 MIL (C)MSA	231.1278	7.943	****
250K-999,999 (P)MSA, 10MIL + (C)MSA	215.1012	7.394	****
100-249K (P)MSA, 100K-249,999 (C)MSA	44.2234	2.879	**
100-249K (P)MSA, 1 mill-2,499,999 (C)MSA	114.5283	2.748	**
100-249K (P)MSA, 2.5 - 5MIL (C)MSA	122.6983	1.839	*
100-249K (P)MSA, 5 mill-9,999,999 (C)MSA	183.5684	3.286	***
100-249K (P)MSA,10Milln or more (C)MSA	501.5241	8.258	****
<100K (P)MSA, < 100K (C)MSA	0.5441	0.013	
<100K (P)MSA, 1 mill-2,499,999 (C)MSA	-1.7213	-0.011	
Suppressed: Midwest nonmetro.			
Adj. R square .2872	* Sig at .0101 to .1000		
	** Sig at. .0011 to .0100		

	***Sig. at .0002 to .0010
	**** Sig < = .0001

Table 2B
Regression Results for Subsidized Households: 52 Market Areas.

Variable Description	Coefficient	T Statistic	
Intercept	64.9085	4.808	****
# bedrooms, max is 6	72.8926	15.347	****
numeric: inc11. Family income	-0.006848	-8.744	****
income squared	0.0000000743	5.315	****
dummy: northeast nonmetro	66.0751	2.971	**
dummy: south nonmetro	5.9158	0.354	
dummy: west nonmetro	87.3382	3.341	***
1 mil+ (P)MSA, 1-2.5mil (C)MSA. in Northeast region	92.473	2.91	**
1 mil+ (P)MSA, 2.5-5mil (C)MSA. in Northeast region	269.0009	10.08	****
1 mil+ (P)MSA, 5-10 mil (C)MSA. in Northeast region	115.0904	4.028	****
1 miL+ (P)MSA, 10mill+ (C)MSA. in Northeast region	181.0454	12.483	****
250K-1MIL (P)MSA, 250K-500K (C)MSA. in Northeast region	95.445	2.968	**
250K-1MIL (P)MSA, 500K-1MIL (C)MSA. in Northeast region	103.058	4.803	****
250K-1MIL (P)MSA, 1-2.5 mil (C)MSA. in Northeast region	144.0497	4.468	****
250K-1MIL (P)MSA, 2.5-5 mil (C)MSA. in Northeast region	193.2148	2.988	**
250K-1MIL (P)MSA, 5-10 mil (C)MSA. in Northeast region	69.3912	0.831	
250K-1MIL (P)MSA, 10 mil+ (C)MSA. in Northeast region	213.1225	6.727	****
100-249K (P)MSA, 100K-250k (C)MSA. in Northeast region	117.2882	3.279	**
100-249K (P)MSA, 1- 2.5ML (C)MSA. in Northeast region	33.4047	0.704	
100-249K (P)MSA, 2.5-5ML (C)MSA. in Northeast region	198.2841	2.551	*
100-249K (P)MSA, 5-10ML (C)MSA. in Northeast region	94.4439	1.082	
100-249K (P)MSA, 10ML+ (C)MSA. in Northeast region	496.8963	8.041	****
<100K (P)MSA, < 100K (C)MSA. in Northeast region	145.5284	0.931	
<100K (P)MSA, 1-2.5 mil (C)MSA. in Northeast region	39.7648	0.242	
1 mil+ (P)MSA, 1- 2.5ML (C)MSA. in Midwest region	77.9023	4.116	****
1 mil+ (P)MSA, 2.5 to 5ML (C)MSA. in Midwest region	41.2721	1.577	
1 mil+ (P)MSA, 5 to 10ML (C)MSA. in Midwest region	195.4155	9.442	****
250K-1ML (P)MSA, 250K-500K (C)MSA. in Midwest region	57.9785	2.068	*
250K-1M (P)MSA, 500K-1MIL (C)MSA. in Midwest region	46.0513	1.518	
250K-1ML (P)MSA, 1-2.5 mil (C)MSA. in Midwest region	24.6221	0.465	
250K-1MIL (P)MSA, 2.5-5 mil (C)MSA. in Midwest region	46.1148	0.84	
250K-1MIL (P)MSA, 5-10mil (C)MSA. in Midwest region	239.5434	6.266	****
100-249K (P)MSA, 100K-250k (C)MSA. in Midwest region	22.2413	0.97	
<100K (P)MSA, < 100K (C)MSA. in Midwest region	15.4317	0.208	
1 mil+ (P)MSA, 1 to 2.5mil (C)MSA. in South region	67.2358	3.908	****
1 mil+ (P)MSA, 2.5 to 5mil (C)MSA. in South region	120.71	6.102	****
250K-1MIL (P)MSA, 250K- 500K (C)MSA. in South region	5.0394	0.218	

250K-1MIL (P)MSA, 500K-1MIL (C)MSA. in South region	50.4172	2.723	**
250K-1MIL (P)MSA, 5 TO 10 mil (C)MSA. in South region	115.9746	1.263	
100-249K (P)MSA, 100K-250k (C)MSA. in South region	24.2811	1.257	
100-249K (P)MSA, 2.5 TO 5 mil (C)MSA. in South region	172.294	1.26	
<100K (P)MSA, < 100K (C)MSA. in South region	-49.153	-0.871	
1 mil+ (P)MSA, 1 to 2.5mil (C)MSA. in West region	116.8517	6.11	****
1 mil+ (P)MSA, 5 to 10 mil (C)MSA. in West region	344.9969	13.122	****
1 miL+ (P)MSA, 10mill+ (C)MSA. in West region	193.0833	9.72	****
250K-1MIL (P)MSA, 250-500K (C)MSA. in West region	37.4667	1.288	
250K-1MIL (P)MSA, 500K-1MIL (C)MSA. in West region	112.4026	3.456	***
250K-1MIL (P)MSA, 1-2.5mil (C)MSA. in West region	-85.8779	-0.605	
250K-1MIL (P)MSA, 5-10mil (C)MSA. in West region	263.7605	4.592	****
250K-1MIL (P)MSA, 10 mil+ (C)MSA. in West region	213.9195	2.925	**
100-249K (P)MSA, 100K-250k (C)MSA. in West region	118.354	3.235	**
100-249K (P)MSA, 1- 2.5 mil (C)MSA. in West region	293.9189	3.283	***
100-249K (P)MSA, 5- 10 mil (C)MSA. in West region	230.1634	3.121	**
<100K (P)MSA, < 100K (C)MSA. in West region	-70.9035	-0.562	
Suppressed: Midwest nonmetro.	* Sig at .0101 to .1000		
Adj. R square .3070	** Sig at .0011 to .0100		
	*** Sig at .0002 to .0010		
	**** Sig <= .0001		

1. This description of the existing model comes from our efforts to replicate the 1985 subsidies. We were aided by computer programs and written spreadsheets that existed for parts of the method. To our knowledge, this is the first documentation of the method.
2. One important service, public schools, is not included in the index.
3. Specifically, the monthly housing cost of each subsidized renter was computed by applying the following equation where the intercept and regression coefficients (i.e. beta *n*) from the regression equation for nonsubsidized renters in two bedroom units were applied to the characteristics reported by the subsidized renters in two bedroom units.
Monthly housing cost = a + betal*baths + beta2 * appliances
+ beta3 * problems + beta4 * satisfaction. +
4. Subsidized renters are those who either live in public housing, receive federal, state or local assistance with housing costs, or report their income for purposes of setting rent. In the existing model, renters who report their income for purposes of setting rent do not appear to be included among subsidized renters, but their counterparts, renters who do not report their income for purposes of setting rent, are included among nonsubsidized renters. We include renters who report their income for the purpose of setting rent as subsidized. Respondents with missing data in each of the four housing subsidy questions do not appear to be included in the original model.
5. Metropolitan Housing Characteristics, 1980. Table D2.
6. Note that there is both a CPI rent index and a CPI residential rent index. The residential rent index is the appropriate index to use.
7. Citro and Michael, 1995, pg. 8.
8. In the model with 21 housing markets, the regression coefficient for central air conditioning is negative and significant. The coefficient for clothes dryer is positive, as predicted, but it is not significant.
9. For the remainder of this paper, we compute a subsidy estimate for each household and calculate the average of these subsidy amounts. In contrast, the original method computed the subsidy estimate as the difference between the two averages for predicted and actual housing costs. If the latter method were used the average subsidy would be $217.
10. Variables are limited to those that are available on the AHS, CPS and Survey of Income and Program Participation (SIPP).
11. For 1995 and later years they were set at the 40th percentile.

12. Using HUD's expenditure data as a benchmark overstates subsidy expenditures because public housing 'development and modernization' outlays should be amortized over the life of the improvement rather than deducted in the year of the expenditure. In 1993 and 1995, modernization expenditures were about 7 percent of the total.
13. A parallel paper that examines these issues utilizing Survey of Income and Program Participation data (SIPP) uses a method called Household Methodology #1, which is not computed for CPS data. The method uses a variation for computing the bedroom allocation. In order to facilitate comparisons between the two papers and to avoid potential confusion, our methods retain similar names between these two papers.
14. Source is various Urban Institute memos.
15. Note that this differs from the SIPP paper which reports person level data.