

Controlling for Prices before Estimating SPM Thresholds and the Impact on SPM Poverty Statistics

Thesia I. Garner
Division of Price and Index Number Research
Bureau of Labor Statistics
Postal Square Building, Room 3105
2 Mass. Ave., NE
Washington, DC 20212
garner.thesia@bls.gov
202 691 6576

Juan D. Munoz Henao
Division of Price and Index Number Research
Bureau of Labor Statistics
Postal Square Building, Room 3105
2 Mass. Ave., NE
Washington, DC 20212
munoz.juan@bls.gov
202 691 7654

JEL Categories: C6, C8, D12, I3

DRAFT April 19, 2018

Prepared for the
2018 Society of Government Economists Annual Conference, Washington, DC
April 20, 2018

Acknowledgement and Disclaimer

Earlier versions of this paper were presented at the 2018 Federal Committee on Statistical Methodology Research and Policy Conference, Washington, DC, Southern Economics Association Annual Meetings, Tampa, FL in November 2017 and the ASSA Annual Meetings, Philadelphia, PA in January 2018. Thanks are extended to our SEA and ASSA discussants, Lester Zeager and David S. Johnson, respectively for their comments and suggestions for improvement. The authors also would like to thank Eric B. Figueroa of the Bureau of Economic Analysis for sharing the normalized prices for areas that are based on CPI rents for 2014, and assistance in learning about the estimation methods he and his colleagues used. Thanks also are extended to Trudi Renwick of the Census Bureau for producing alternative Supplemental Poverty Measurement (SPM) poverty rates based on the thresholds produced in this research. The views expressed in this research, including those related to statistical, methodological, technical, or operational issues, are solely those of the authors and do not necessarily reflect the official positions or policies of the Bureau of Labor Statistics or the views of other staff members therein. The authors accept responsibility for all errors. This paper is released to inform interested parties of ongoing research and to encourage discussion of work in progress.

Abstract

Supplemental Poverty Measurement (SPM) thresholds are computed using out-of-pocket spending on food, clothing, shelter, utilities (FCSU), with a multiplier to account for non-work related transportation and personal care. The source of these data is the U.S. Consumer Expenditure Survey (CE). For the production of the thresholds, price adjustments are applied twice: once to update the most recent five years of CE data to threshold year dollars, and second to produce SPM thresholds for over 300 hundred geographic areas. This latter adjustment is applied to the shelter and utilities portion only to reflect local rent prices. However, spatial differences in shelter and utility prices are already embedded in the initial SPM thresholds, and these differences are being ignored in the current estimation. The purposes of this research are to develop a method to determine whether spatial differences in housing costs exist and to examine whether such differences, if they exist, could be a problem for poverty measurement. A regression based approach is used to produce quality-adjusted normalized prices for housing using the CE to identify the presence of spatial differences. This initial research suggests that normalized prices vary across areas and by housing tenure group (i.e., for owners with mortgages, owners without mortgages, and renters). SPM thresholds that account for these differences result in increases in poverty rates (for select demographic groups) of 0.3 to 0.7 percentage points compared to results based on unadjusted expenditures.

Introduction

In the current production of the Supplement Poverty Measurement (SPM) thresholds, prices play two roles: one, to update five-years of consumer spending to threshold year dollars, and two, to adjust “national” thresholds so that they reflect differences in spending on housing across geographic areas. The first adjustment is accomplished by applying the All Items Consumer Price Index-U.S. City Average (CPI-U) to the sum of expenditures for food, clothing, shelter, and utilities (FCSU) at the consumer unit level for consumer units (CU) with two children. The CU data are from the U.S. Consumer Expenditure Interview Survey (CE). The second role of prices is in the conversion of “national” thresholds to sub-national levels. This second adjustment results from a recommendation of the National Academy of Sciences (NAS) Panel on Poverty and Family Assistance (Citro and Michael (1995). The Panel noted that poverty thresholds should reflect differences in process across geographic areas. Subsequently, the Interagency Technical Working Group on Developing a Supplemental Poverty Measure (ITWG) adopted this recommendation and noted that these adjustments be based on the best available data and statistical methodology available. With the first published SPM (Short 2011), the housing (shelter plus utilities) portions of the “national” reference unit thresholds for each housing tenure group -- owners with mortgages, owners without mortgages, and renters – have been adjusted by median rent indexes (MRI) to reflect differences in prices across areas. These geographic indexes are based on American Community Survey (ACS) reports of gross rents plus utilities for two-bedroom apartments with complete kitchens and plumbing (Renwick 2011a, b). For 2016, this second role of prices resulted in the production of 349 geographic adjustment factors applied to the national thresholds (Fox 2017). Research continues on how best to account for geographic differences in prices across areas, for example, see Renwick, Aten, and Figueroa (2014, 2017).¹

Even with research focused on producing subnational SPM thresholds, across area geographic differences in prices have thus far been ignored in the *initial production* of the “national” thresholds. Thus, differences in prices across areas are implicit in what have been considered the “national” thresholds. This was pointed out recently by Bishop, Less, and Zeager (2017). Thus, a third role of prices needs to be considered. The focus of the current research is to estimate normalized-quality adjusted prices and then to apply these to housing expenditures at the CU level before SPM thresholds are produced. As a prototype—and experimentally—we produce three sets of quality-adjusted normalized prices using CE data: for renters, owners with mortgages, and owners without mortgages. Advantages of using the CE for this exercise include the following: implicit prices and thresholds are based on CU level data and the same out-of-pocket spending concept; quality adjustments are based on a larger number of shelter characteristics than are available in the ACS; and we are able to produce separate normalized prices for each housing tenure group. We limit our analysis to the 2014 threshold year and thus CE data from 2010 quarter two-2015 quarter one are used.

Initial results from this study suggests that differences in prices across areas do matter in the initial production of SPM thresholds. SPM thresholds that account for such price differences result in increases in poverty rates (for select demographic groups) of 0.3 to 0.7 percentage points compared to results based on price-unadjusted housing expenditures.

The remainder of this paper is divided into four sections. First is an overview of the methods that underlie the currently published SPM thresholds, along with the proposal to adjust housing expenditures. Next is a description of the methods and procedures followed to produce the area specific quality-adjusted normalized prices. The next section is divided into three parts: regression results, normalized prices, thresholds, and poverty rates. The paper concludes with directions for future research.

¹ As noted by Renwick et al. (2014), a research forum sponsored by the University of Kentucky Center for Poverty Research (UKCPR), in conjunction with the Brookings Institution and the U.S. Census Bureau made suggestions on the geographic adjustments to the poverty threshold. These included the use of quality-adjusted price levels, differentiation by metropolitan areas within states and the inclusion of other components of the consumption bundle.

Estimation of SPM Thresholds

Current Estimation

The SPM thresholds that are currently in use are based on consumer unit level out-of-pocket spending for food, clothing, shelter and utilities (FCSU) plus a little bit more for personal care products and non-work related transportation.² Consumption needs being met through the use of in-kind benefits, such as free and reduced meals or housing subsidies, are not considered. Expenditure data are from quarterly reports of consumer units participating in the U.S. Consumer Expenditure Interview Survey (CE). At the consumer unit level, FCSU expenditures are defined as:

$$FCSU_{i,q} = F_{i,q} + C_{i,q} + S_{i,q} + U_{i,q} \quad (1)$$

where

i = consumer unit

q = quarterly expenditure

I

Five years of quarterly data are used. To produce thresholds for 2014, consumer unit level FCSU expenditures from 2010 quarter two through 2015 quarter one are first converted to 2014 U.S. dollars using the All Items Consumer Price Index-U.S. City Average.

$$FCSU_{i,2014} = \left(\frac{CPI_{2014}}{CPI_{yr}} \right) * FCSU_{i,q} * 4 \quad (2)$$

² FCSU refers to food, clothing, shelter, and utilities. Food expenditures are those for food at home and food away from home. Meals as pay are not counted nor are alcoholic beverages. Food expenditures are not expected to be exact but are collected through the use of global question and refer to “usual weekly” expenditures. Clothing expenditures include those for all the goods and services identified as “apparel” by the CE Division of the BLS. Apparel includes clothing for girls and boys aged 2 to 15, women and men 16 and over, and for children less than 2 years of age. This category also includes footwear and other apparel products and services such as jewelry, shoe repair, apparel laundry and dry cleaning, and clothing storage. Shelter includes expenses for owners and for renters. To create the shelter variable for the SPM thresholds calculation, I restricted shelter expenses to be those for the consumer unit’s primary residence only. For renters, expenditures include those for rent paid, maintenance and repairs paid for by the renter, and tenants insurance. Rent as pay is not included although this rent since no information on this rent is collected in the CPS for resources. For owners, shelter expenses include those for property taxes and insurance, maintenance and repairs, and for those with mortgages, and mortgage interest and principal payments. As for renters, all expenditures are restricted to those for the CU’s primary residence. Unlike for the expenses of renters and owners without mortgages, mortgage shelter expenditures reflect obligations, not necessarily what the consumer unit paid. The CE Survey collects information about the terms of the mortgage or mortgages on the primary residence. Then staff members at the BLS who work with the CE data calculate the obligated payments. If property taxes and insurance are included in the mortgage payment, these too are calculated by these staff members for the consumer unit. Utility expenditures are those for: energy including natural gas, electricity, fuel oil and other fuels; telephone services including land lines, cell service, and phone cards; and water and other public services such as trash and garbage collected, and septic tank cleaning. For owners, these are for the primary residence only. For renters, these are for any utilities for which they are obligated to pay with the exception of rented vacation homes. The amount recorded by the respondent is for what is charged or billed, not what the consumer unit necessarily pays. The exception regarding questioning for utilities is for telephone cards; consumer units are asked about the purchase price of pre-paid telephone and cellular cards and their spending for using public telephones.

The ITWG recommended that thresholds be based on the experience of consumer units (CUs) with two children. However, to derive thresholds for consumer units composed of differing number of adults and children, an equivalence scale is used. The equivalence scale is first used to convert expenditures from CUs with two children to expenditures for exactly two adults with two children, the reference unit. This adjustment is done at the CU level as well. As recommended in the ITWG guidelines, a three-parameter equivalence scale is used to adjust FCSU expenditures. The three-parameter scale allows for a different adjustment for single parents (Betson 1996). The three-parameter scale is shown below.

$$\text{One and two adults: } scale = (adults)^{0.5} \quad (3a)$$

$$\text{Single parents: } scale = (adults + 0.8 * firstchild + 0.5 * otherchildren)^{0.7} \quad (3b)$$

$$\text{All other families: } scale = (adults + 0.5 * children)^{0.7} . \quad (3c)$$

The equivalence scale for two adults is set to 1.41. The economy of scales factor is set at 0.70 for other consumer unit types. These same equivalence scales are used again later in the estimation process to produce thresholds that reflect differing number of adults and children.

Once estimation sample CUs' expenditures are converted to reference unit expenditures, the next step is to produce expenditures for aggregated groups of consumer units. The ITWG document stated that reference unit SPM thresholds would be based on a range of FCSU expenditures. To obtain this range, all consumer units in the estimation samples are ranked from lowest to highest by the value of their threshold year dollar two adult-two child equivalent FCSU expenditures. Data are population weighted for this ranking. The SPM thresholds are based on a range of expenditure around the 33rd percentile of FCSU expenditures. The range is defined as within the 30th and 36th percentile points in the FCSU distribution. Restricting the estimation sample to this range of expenditures results in thresholds that are based on the expenditures of a subsample of the original estimation sample composed of two-child consumer units.

As recommended by the ITWG, separate SPM thresholds are to be produced for owners with mortgages, owners without mortgages, and renters. For 2014, the experimental SPM housing tenure thresholds are estimated using equation (4).

$$SPM_{j,2014} = 1.2 * FCSU_{R,2014} - SU_R + SU_j \quad (4)$$

where:

- j housing tenure group: owners with mortgage, owners without mortgages, or renters
- 1.2 multiplier used to account for expenditures for other basic goods and services, like those for household supplies, personal care, and non-work related transportation
- $FCSU$ mean of the sum of expenditures for food, clothing, shelter and utilities for the A weighted sample of CUs
- R reference consumer units without distinction by housing tenure within the 30th to 36th percentile range of FCSU expenditures
- SU_A, SU_j mean of the sum of expenditures for shelter plus utilities portions of FCSU for the A weighted sample of CUs and for j housing tenure groups within the 30-36th percentile FCSU range.

The next step is to adjust these “national” thresholds by geographic price adjustments to derive subnational thresholds. For this, only the housing or “SU” portions of the thresholds are adjusted. The SU portions are derived as follows:

$$\alpha_j = \frac{SU_j}{SPM_j} \quad (5)$$

where:

α_j housing share of reference unit threshold for housing tenure group j .

The geographically adjusted thresholds are produced as in equation 6.

$$SPM_{j,g,2014} = [(\alpha_j * MRI_g) + (1 - \alpha_j)] * SPM_{j,2014} \quad (6)$$

where

g geographic area

MRI Median rent index based on gross rents plus utilities for 2-bedroom apartments with complete kitchens and baths

Proposal to Adjust Housing Expenditures at the Consumer Unit Level

To adjust for spatial differences in the price of housing before producing the initial thresholds, we propose adjusting consumer unit level housing expenditures by area specific quality adjustment normalized prices. Equation (7) would replace equation (1) in the threshold estimation procedure. After adjusting housing expenditures, the same steps (equations 2-6) would follow as before to produce the SPM thresholds.

$$FCSU'_{i,q} = F_{i,q} + C_{i,q} + \frac{S_{i,q} + U_{i,q}}{QANP_{a,j}} \quad (7)$$

where

$QANP_{a,j}$ quality-adjusted normalized price for area a and housing tenure group j

One might ask why not use the MRI adjust CE housing expenditures. We chose not to do this as the CE and ACE sampling methodologies and survey designs are different. Our aim was to use the data underlying the thresholds and make adjustments with the data available.

Producing Normalized Prices: Methods and Procedures

To derive the CE-based quality-adjusted normalized prices, we pool five years of CE data that match the years used for the production of the SPM thresholds (2010 Quarter two through 2015 quarter one). Unlike for the SPM thresholds, all consumer units are considered “in sample” for the estimation with one restriction: consumers reporting less than positive renter or owner expenditures are excluded.³ Area-specific normalized prices are based on weighted log-linear expenditure regression model estimations. Out-of-pocket expenditures for shelter and utilities for consumer units’ primary residence are regressed on variables representing geographic areas and controls for housing structure and survey year. Due to differences in housing structure, separate regressions are run for each of the housing tenure groups: owners with mortgages, owners without mortgages, and renters.

³ CUs living in student housing are excluded from both the sample underlying the estimation of the SPM thresholds and the normalized price regressions.

Since SPM thresholds are based on out-of-pocket (OOP) spending, we propose that the preferred prototype geo-price adjustment be based on OOP spending on the same types of housing expenditures. Counting both shelter and utilities together in the estimation of the CE-based normalized prices is consistent with the approach followed by Renwick (2011) in the production of the American Community Survey (ACS) median rent index (MRI). For this study, owner shelter expenses include mortgage principal payments, interest on mortgages, property taxes and insurance, ground rent, expenses for property management and security, homeowners' insurance, fire insurance and extended coverage, expenses for repairs and maintenance contracted out, and expenses of materials for owner-performed repairs and maintenance for dwellings used or maintained by the consumer unit. Renter shelter expenses include rent paid for dwellings, rent received as pay, parking fees, maintenance, and other expenses. Rental shelter expenditures reported by consumer units living in subsidized rental units, public housing, or rent controlled units are those paid by the CU and do not include the value of any subsidies. Utilities include those for natural gas; electricity; fuel oil and other fuels, such as wood, kerosene, coal, and bottled gas; water and other public services, such as garbage and trash collection, sewerage maintenance, septic tank cleaning; and telephone charges. Any subsidies received in-kind for utilities are not counted.⁴

Unlike for the estimation of the SPM thresholds previously published, the housing portion of the SPM thresholds will not include telephone expenditures. Expenditures for telephone services are not included in utilities for the estimation of the quality-adjusted normalized prices. This decision was made for two reasons. One, cell telephone service expenditures now represent approximately 73 percent of all telephone service expenditures, and thus are less likely to be tied to the housing structure. When the NAS Panel included telephone services in housing utilities, cell telephone service expenditures were not reported by the BLS because the value was too small.⁵ And two, not including telephone services in utilities is consistent with the definition of utilities included in the calculation of the Median Rent Indexes (MRI) produced by Renwick (2011) and by Martin et al. (2011). This decision results in telephone expenditures being treated in the same way as food and clothing in the production of the threshold. As a result of not including telephone expenditures in utilities, a smaller share of the new SPM thresholds will be allocated to housing and thus subject to the price adjustment used to produce subnational SPM thresholds (see equation 6).

Housing structure characteristics enter the regression models as control variables. For both the renter and owner models, these include the following: type of structure, number of bedrooms, number of full bath, number of half baths, total number of rooms (not in the owner with mortgages model), dwelling year of construction, whether the unit has central air conditioning, whether the unit has off street parking (not in the owner with mortgage model), and dummy variables for the survey years. The

⁴ In order to better understand the differences in the CE-based indexes and those produced by Renwick (2011) and the Martin et al. (2011), differences in the definition of rents are highlighted. Median Rent Indexes (MRI) are from the American Community Survey (ACS) and reflect the median *gross* rents plus utilities for 2-bedroom apartments with complete kitchens and plumbing; in contrast, the CE-based indexes are quality-adjusted weighted geometric means estimated using a hedonic model that controls for housing unit characteristics. Martin et al. (2011) use both the ACS and the CPI Housing Survey for their estimation of normalized rents. Rents from the CPI Housing Sample is defined to include what the tenant pays plus the value of rent as pay and rental subsidies paid to landlords as applicable. Not included in the CPI Housing Sample of renters are student or public housing (Penrose 2017); public housing rents are included in the CE rent measure. For the CPI Housing Survey, expenditures for utilities are not counted as rent unless already included in reported rents. The ACS variable used by Martin et al. (2011) is *contract* rent: “the monthly rent agreed to or contracted for, regardless of any furnishings, utilities, fees, meals, or services that may be included. For vacant units, it is the monthly rent asked for the rental unit at the time of interview... The respondent was to report the rent agreed to or contracted for even if paid by someone else such as friends or relatives living elsewhere, a church or welfare agency, or the government through subsidies or vouchers” (Census 2016).

⁵ In 1992, the year underlying the NAS Panel’s FCSU expenditures, no data were reported for cell telephone service expenditures or the value was too small to display. By 1995, the year the NAS Panel’s report was released, mean cell telephone service expenditures represented about 3.6% of telephone service expenditures. By 2016, they represented 78.5 percent (see: <https://stats.bls.gov/cex/tables.htm#annual>).

owner models also include an additional control variable: has a porch or balcony. The rent model in addition includes the following: whether energy utilities are included in the rent, whether water and trash pickup are included in the rent, if the unit is in public housing, whether the CU receives a subsidy to help pay the rent, whether the unit is rent controlled, and whether part of the rent is considered rent as pay.

The quality-adjusted normalized prices are produced for geographic areas in which U.S. Consumer Expenditure Interview Survey data are collected. These areas are referred to as primary sampling units (PSUs). The CE is used to collect data in both urban and rural PSUs. The areas for which quality-adjusted normalized prices are produced are listed in Table 1. Dummy variables for these areas enter the regression models. In order to facilitate a comparison of results from this study with those from earlier work, we define 38 non-rural geographic areas following Martin, Aten, and Figueroa (2011) in their estimation of quality adjusted normalized rents using the Consumer Price Index (CPI) Housing Survey⁶ and the American Community Survey. Of these 38 PSUs, 31 are considered to be large metropolitan areas (labeled “A” size areas). Small metropolitan PSUs are aggregated into four regional groupings (labeled “X”), and nonmetropolitan urban (labeled “D”) PSUs areas are regrouped into three regional groupings. Unlike in the Martin et al. study, normalized prices for CUs living in rural PSUs are produced as well; rural PSUs also are grouped by region (labeled “R”). It should be noted that three of the PSUs defined by Martin et al. as being large metropolitan were demoted to the small metropolitan category by BLS beginning with 2005 quarter two. The three areas are Milwaukee-Racine, WI (was A212 became X212; restricted to Milwaukee), Cincinnati-Hamilton, OH-KY-IN (was A213 became X218; restricted to Cincinnati), and Kansas City, MO-KS (A214 became X226; restricted to Kansas City, MO). However, again, to be consistent with Martin et al., these three PSUs remain with the original 31 A size cities for the analysis.⁷

The hedonic model used for the estimation of the quality-adjusted normalized prices is presented in equation (8). As noted earlier, log housing expenditures are regressed on dummy variable representing geographic areas and housing structure characteristics.

$$\ln P_{mj} = a_0 + \sum_{m=1}^M a_m A_{ij} + \sum_{n=1}^N \sum_{j=1}^{J(n)} B_j^n Z_{mj}^n + e_{mj} \quad (8)$$

where

A_{mj}	set of area dummies
Z_{ij}^n	set of shelter unit characteristics
$m=1, \dots, M$	geographic areas
$j=1, \dots, J(n)$	classifications
$n=1, \dots, N$	characteristics

Shelter unit characteristics enter the equation as classification variables. For example, shelter unit structure is defined in terms of whether the housing unit is a detached housing unit, attached housing unit, mobile home, in a building with two to nine units, in a building with 10 or more units, or otherwise not defined. The total number of rooms enters as a continuous variable. PROC GLM in SAS is used for the analysis; all results are population weighted. Relative differences in renter and owner expenses across areas are represented by the area coefficients, holding all other characteristics constant. Differences in expenditure levels across areas are derived using the SAS statement LSMEANS by area. For each housing tenure group separately, the geometric mean across areas, weighted by CE population

⁶ The CPI Housing Survey does not collect data from rural areas.

⁷ For future reference, note: In January 2018, BLS will introduce a new geographic area sample for the Consumer Price Index (CPI); the new geographic area sample was introduced for the CE in 2015. These new samples are based on the 2010 Decennial Census.

weights, is equal to 1.0. Martin et al. (2011) also based their quality adjusted “prices” on geometric means; however, they weighted the area results by rent shares for the normalization. For example, for renters, the quality-adjusted normalized “price” for an area is relative to the U.S. average “price.” For example, if the quality-adjusted normalized price for Washington, DC is 1.46 for renters, this means that renters’ prices (expenditures in our study) are about 46 percent higher than renter prices on average for the U.S., holding housing unit characteristics constant.

Results

The results from the regression estimations, SPM thresholds with housing expenditures adjusted prior to estimation, and poverty rates based on these thresholds are presented in this section.⁸ First presented are the results related to the estimation of the quality-adjusted normalized prices. This is followed by a description of changes in the sample underlying the SPM thresholds. The final two sections include SPM thresholds and poverty rates.

Quality-Adjusted Normalized Prices

The estimation of quality-adjusted normalized prices and comparisons to other published prices are presented in this section. Table 2 includes summary statistics from the regression models. These results are followed by the quality-adjusted normalized prices for each geographic areas by housing tenure status in Table 3. Table 4 and 5 include comparisons to the work by others.

As seen in Table 2, the hedonic log-linear models for renter and owners expenditures fit the data relatively well for cross-sectional household survey data. These results are in line with those reported by Martin et al. (2011) for rents using five years of data from another household survey, the ACS. As seen in the Table 3, the rural South has the lowest quality-adjusted normalized rents for each of the housing tenure groups. However, the quality-adjusted normalized prices are highest for New York City rents, San Francisco-Oakland-San Jose, CA for owner with mortgage prices, and New York-Connecticut Suburbs for owner without mortgage prices. The areas with prices approximately the same as the U.S. average follow: for rents, Portland-Salem, OR-WA; for owners with mortgages, Dallas-Fort Worth, TX; and for owners without mortgages, St. Louis, MO-IL.

Table 2. Overall Fit of Log-linear Weighted Regression Models Using Pooled Data 2010Q2-2015Q1

Dependent Variable	Full Sample		
	R Square	Root MSE	Unweighted observations
Rent plus utilities	0.424	66.15	44,457
Owner with mortgages plus utilities	0.410	59.53	46,652
Owner without mortgages plus utilities	0.316	79.86	32,236

Table 4 includes simple correlations of the quality-adjusted normalized prices estimated from this study with those previously published by Martin et al. (2011) using data from an earlier time period (2005-2009). In this latter study, prices for rural areas were not considered. Thus, for the comparison, we follow an earlier convention used by the BEA researchers and assign certain of the 2014 the same quality-adjusted normalized rent prices from other areas to be representative of rural areas. Specifically we assign the Northeast small metropolitan price to also be representative of the rural Northeast, the Midwest nonmetropolitan urban normalized rent price is assigned to the rural Midwest, the South nonmetropolitan urban price is assigned to the rural South, and the West nonmetropolitan urban price is assigned to the rural West. With these assignments to rural areas, the correlations between the CE-based results with those based on the CPI Housing Survey and the ACS are quite high (0.93-0.95). Not surprisingly the correlations of the quality adjusted normalized owner prices and rents from the Martin et al. (2011) are lower for owners. These results suggest that if one would adjust owner out-of-pocket

⁸ A future version of the paper will include weighted sample statistics and estimated regression parameters.

Table 3. Quality-Adjusted Normalized Renter and Owner Expenditures by Primary Sample Unit (PSU)Areas: CE Interview Data 2010Q2-2015Q1

		Geometric Means (Normalized)		
		Renter	Owner	
		Rents + Utilities	Mortgage Principal and Interest, Homeowner Insurance, Property Taxes, M&R + Utilities	Homeowner Insurance, Property Taxes, M&R + Utilities
PSU Area	PSU Description			
A102	Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	1.238	1.233	1.443
A103	Boston-Brockton-Nashua, MA-NH-ME-CT	1.276	1.399	1.682
A104	Pittsburgh, PA	0.827	0.901	1.110
A109	New York City	1.791	1.707	1.871
A110	New York-Connecticut Suburbs	1.555	1.696	2.295
A111	New Jersey-Pennsylvania Suburbs	1.558	1.659	2.227
A207	Chicago-Gary-Kenosha, IL-IN-WI	1.233	1.230	1.377
A208	Detroit-Ann Arbor-Flint, MI	0.894	0.970	1.155
A209	St. Louis, MO-IL	0.864	0.889	1.002
A210	Cleveland-Akron, OH	0.882	0.936	1.106
A211	Minneapolis-St. Paul, MN-WI	1.084	1.081	1.111
A212	Milwaukee-Racine, WI	0.956	1.116	1.352
A213	Cincinnati-Hamilton, OH-KY-IN	0.860	0.874	0.986
A214	Kansas City, MO-KS	0.863	0.875	0.989
A312	Washington, DC-MD-VA-WV	1.461	1.211	1.234
A313	Baltimore, MD	1.186	1.105	1.144
A316	Dallas-Fort Worth, TX	0.998	1.001	1.152
A318	Houston-Galveston-Brazoria, TX	0.957	0.960	1.180
A319	Atlanta, GA	0.958	0.848	0.831
A320	Miami-Fort Lauderdale, FL	1.194	1.038	0.944
A321	Tampa-St. Petersburg-Clearwater, FL	0.943	0.910	0.911
A419	Los Angeles-Long Beach, CA	1.425	1.477	1.158
A420	Los Angeles Suburbs, CA	1.170	1.178	0.974
A422	San Francisco-Oakland-San Jose, CA	1.532	1.781	1.291
A423	Seattle-Tacoma-Bremerton, WA	1.153	1.288	1.395
A424	San Diego, CA	1.410	1.467	1.075
A425	Portland-Salem, OR-WA	0.999	1.178	1.268
A426	Honolulu, HI	1.475	1.436	1.127
A427	Anchorage, AK	1.367	1.396	1.572
A429	Phoenix-Mesa, AZ	0.911	0.923	0.947
A433	Denver-Boulder-Greeley, CO	1.038	1.002	0.817
D200	Midwest nonmetropolitan urban	0.642	0.819	0.973
D300	South nonmetropolitan urban	0.726	0.774	0.738
D400	West nonmetropolitan urban	0.829	0.992	0.967
X100	Northeast small metropolitan	0.933	0.975	1.213
X200	Midwest small metropolitan	0.795	0.871	0.976
X300	South small metropolitan	0.829	0.827	0.802
X499	West small metropolitan	0.811	0.874	0.786
R100	Northeast rural	0.971	0.732	1.035
R200	Midwest rural	0.646	0.781	0.863
R300	South rural	0.615	0.721	0.683
R499	West rural	0.858	1.144	0.932
	Weighted Geometric Mean	100.000	100.000	100.000

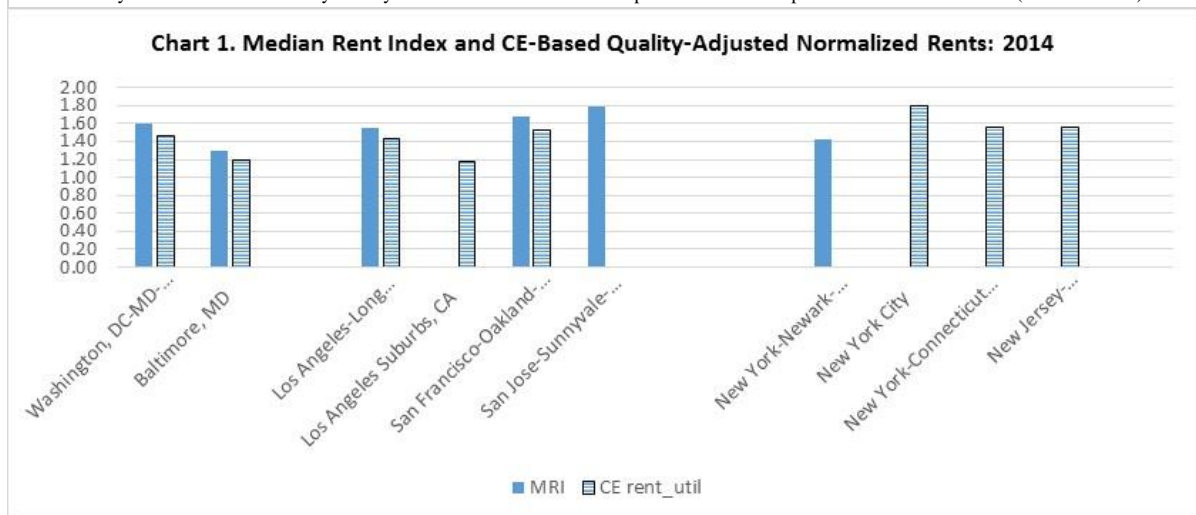
spending by quality-adjusted normalized rents, resulting thresholds would not adequately reflect the prices faced by owners.

CE-based quality-adjusted normalized prices are compared to Median Rent Indexes (MRI) for 2014 in Table 5. As noted earlier, the MRIs are applied to the “national” thresholds in order to produce subnational. MRIs are based on gross rents plus utilities as collected in the American Community Survey. Based on an examination of the maximum and minimum rents, the two sources of data result in similar values. The quality adjusted normalized owner with mortgage values are close as well; however, those for owners without mortgage diverge the most. In Chart 1 rent indexes for a select number of geographic areas are shown. CE-based area indexes are presented in comparison to MRIs from the ACS. Although we do not recommend that the ACS indexes to adjust micro-level housing expenditures before estimating the FCSU thresholds, seeing how well the CE indexes compare provides us reassurance regarding the modeling approach that we use. Areas indexes are produced for the following areas for both the CE and ACS: Washington, DC, Baltimore, MD, Los Angeles-Long Beach, CA, and San Francisco-Oakland, CA. Only one index is available from the ACS for the New York City and surrounding area. However, with the CE we are able to produce indexes for three areas within the New York City area, The CE disaggregation suggests that differences in prices within the area are important.

CE Quality-Adjusted Normalized Rent Prices (2010Q2-2015Q1)	BEA Quality Adjusted Normalized Rent Prices	
	CPI Housing Survey (2005-2009)	ACS (2005-2009)
Renter shelter and utilities	0.951	0.931
Owner with mortgages shelter and utilities	0.913	0.861
Owner without mortgages shelter and utilities	0.633	0.546

	CE Interview Survey			ACS
	Renter S+U	Owner with Mortgage S+U	Owner without Mortgage S+U	MRI 2014 ^a
Maximum	1.791	1.781	2.290	1.782
Minimum	0.615	0.721	0.680	0.595
Range	1.176	1.060	1.610	1.187
Ratio of Max to Min	2.912	2.470	3.368	2.996

^a Based on 5-year American Community Survey median rents for 2-bedroom apartments with complete kitchens and full baths (Renwick 2017).



SPM Sample and Thresholds

The impact of adjusting housing expenditures, by CE-based quality-adjusted normalized prices before producing the SPM thresholds, on the underlying sample and thresholds are presented in this section. Housing expenditures (not including those for telephone) for each consumer unit (CU) in the CE Interview Survey are adjusted by one of the area specific quality-adjusted normalized prices based on the geographic area where the CU lives and the CU's housing tenure. These adjusted housing expenditures are added to price unadjusted expenditures for food, clothing, and telephone. Next these FCSU expenditures are converted to 2014 dollars using the all items CPI-U U.S. City Average. FCSU expenditures for the estimation sample of CUs with two children are further adjusted using the 3-parameter equivalence scale; this results in equalized FCSU expenditures for two adults with two children, the reference SPM unit. Changes in the underlying SPM reference samples and thresholds, resulting from applying quality-adjusted normalized prices to individual CU housing expenditures, are presented in this section.

Underlying Weighted Sample. As noted earlier, SPM thresholds are based on the 30-36th percentile range of 2-adult-2-child equalized FCSU expenditures. When the CE-based quality-adjusted normalized prices are applied to CU level housing expenditures initially, as proposed in this study, the ranking of FCSU changes. The new ranking results in a larger percentage of owners without mortgages (from 10.8% to 12.5% of the sample) and renters (47.6% to 48.4%) with a reduction in the owners with mortgages (41.5% to 39.2%). Regional changes also result with the Northeast gaining greater representation in the weighted sample (from 12.8% to 19.1%); the South losses the most by 3.8 percentage points (from 41.7 % to 37.9%); while the representation by the Midwest and West remains about constant around 22 percent. When examined with respect to the 42 geographic areas underlying the CE-based normalized prices, we find the largest percentage gains for the New York-Connecticut suburbs and the largest losses for the South small metropolitan area.⁹

SPM Thresholds for Two Adults with Two Children. SPM thresholds for the reference unit are presented in Table 6. Three sets of thresholds are presented: (1) currently published (BLS 2017); (2) thresholds based on telephone not being included in utilities; and (3) thresholds with the CE-based quality-adjustment to shelter and non-telephone utility expenditures. In all instances, the thresholds for owners with mortgages are highest, followed by those for renters and then owners without mortgages. Not including telephone services as part of utilities results in a decrease of \$310 for owners without mortgages; thresholds for the other two group also decrease by minimally. When housing expenditures (again not including telephone services) are adjusted for by CE-based quality-adjusted normalized prices, SPM thresholds for owners with mortgages increase by \$483 (or 1.9%), they increase by \$612 (or 2.9%) for owners without mortgages, and by \$264 (or 1.0%) for renters.

	Housing Expenditures Not Adjusted		Housing Expenditures Adjusted
	Published	Utilities do not include Telephone	Utilities do not include Telephone
Owners with mortgages	\$25,844	\$25,840	\$26,327
Owners without mortgages	\$21,380	\$21,070	\$21,992
Renters	\$25,460	\$25,534	\$25,724

For the 2-adult-w-child SPM “national” thresholds to be adjusted to produce subnational thresholds, the housing shares of the thresholds are needed as it is only the housing portion of the thresholds that are adjusted by the MRI (see equation 6).¹⁰ Housing expenditure shares implicit in the 2014 SPM thresholds are presented in Table 7. Not surprisingly, the shares for utilities fall due to the omission of telephone from utilities with the greatest percentage point decrease for owners without

⁹ A chart showing the distributions of weighted CUS by housing tenure based on the published, unpriced adjusted ranking, and based on the price adjusted housing expenditures is available upon request.

¹⁰ For a discussion of geographic adjustment methods and research, see Renwick (2011). Also see Ziliak (2010).

mortgages (5.8 percentage points). The housing shares of the thresholds drops from 50.7% (published) to 45.1% (with price adjustment and telephone not in utilities) for owners with mortgages, for renters it 50% to 43.8% for renters, and 40.4% to 34.4% for owners without mortgages.

		Housing Expenditures Not Adjusted		Housing Expenditures Adjusted	
		Published	Utilities do not include Telephone	Utilities include Telephone	Utilities do not include Telephone
Owners	with Mortgages				
	shelter	34.1%	34.1%	34.1%	34.1%
	utilities	16.6%	13.5%	16.6%	11.1%
	<i>housing total</i>	50.7%	47.7%	50.6%	45.1%
Renters					
	shelter	36.4%	36.3%	35.5%	35.5%
	utilities	13.6%	8.2%	13.9%	8.3%
	<i>housing total</i>	50.0%	44.5%	49.5%	43.8%
Owners	without mortgages				
	shelter	18.3%	18.5%	17.9%	17.9%
	utilities	22.2%	14.2%	23.0%	16.4%
	<i>housing total</i>	40.4%	32.7%	40.9%	34.3%

Chart XX includes population poverty rates based on the three threshold concepts after than have been further adjusted to account for differing numbers of adults and children and after adjustments to produce subnational thresholds that reflect differences in the cost of housing. Resources are compared to SPM threshold to produce poverty rates for the U.S. population using data from the Current Population Survey Annual Social and Economic Supplement. Poverty rates are produced for the year 2014.

Poverty Rates

Poverty rates are presented in Table 8 with and without telephone services included in housing, and with and without the CE-based normalized price adjustments applied to housing expenditures before estimating the 2-adult-2child SPM thresholds. AS noted earlier, before poverty rates could be produced using these thresholds, they were adjusted to account for different numbers of adults and children and also to reflect median rents for areas as defined in the ACS by Renwick. Overall poverty increased with the CE-based housing price adjustments, from 15.3% to 15.8 % of the population. For thresholds with the CE-price adjustment, including telephone as part of utilities impacted people living outside metropolitan statistical areas (with an increase from 13.3% to 13.9%). Few other differences resulted.

Discussion and Conclusion

In the SPM thresholds used for poverty statistics, implicit differences in prices across areas exist. The underlying assumption is that these differences do not matter. However, this assumption is largely untested, with the possible exception of Bishop et al (2017). The purpose of this study was to examine the impact of accounting for spatial differences in housing prices across areas before estimating the SPM thresholds, and thus to make adjustments at the consumer unit level. To do this, first quality-adjusted normalized prices were produced using CE data, the same data that are used for the production of the SPM thresholds. Normalized area-specific prices were produced separately for owners with mortgages, owners without mortgages, and renters. The CE data were used in order to account for prices faced by renters and owners for shelter and utilities in their out-of-pocket expenditures. The normalized prices produced in this study, at least for a select number of areas, are quite similar to those produced by Renwick (2017) using gross rents from the American Community

Survey. Other indexes that account for differences by area are the rent regional price parities (RPPs), and food-apparel-rent FAR RPPs (Renwick et al. 2017). However, these are not based on the same geography as the SPM thresholds nor are the definitions of housing expenditures the same.

A goal of this study was to develop a prototype approach is to adjust consumer unit specific housing expenditures for consumer unit expenditures underlying the SPM thresholds. Although the impact on SPM poverty rates appears to be small, we think that these underlying differences are importance and should be accounted for before estimation “national” thresholds. Future work includes refining the hedonic model used to produce the normalized area-specific prices to account for geographic areas. Another avenue of research to consider is a multilateral index methodology that accounts for the full bundle of FCSU, more like the FAR PPPs produced by Renwick et al. (2017).

Table 8. Percentage of SPM Poor Based on Published SPM Thresholds with and without Housing Adjusted

		Published	Housing Expenditures Adjusted	
			Utilities include Telephone	Utilities do not include Telephone
All People		15.3	15.8	15.8
Residence	Outside metropolitan statistical areas	12.8	13.3	13.9
	Outside principal cities	13.1	13.7	13.5
	Inside principal cities	20.2	20.6	20.6
	Inside metropolitan statistical areas	15.8	16.3	16.2
Region	West	18.4	18.7	18.4
	South	15.6	16.3	16.5
	Midwest	11.8	12.2	12.5
	Northeast	14.7	15.1	15.0
Tenure	Renter	26.1	26.6	26.7
	Owner/no mortgage/rentfree	13.0	13.7	13.7
	Owner/mortgage	8.1	8.4	8.4

References

Aten, Bettina, Eric Figueroa, and Troy Martin, “Notes on Estimating the Multi-Year Regional Price Parities by 16 Expenditure Categories: 2005-2009,” 2011, https://www.bea.gov/papers/pdf/notes_on_estimating_the_multi_year_rpps_and_appendix_tables.pdf.

Bishop, John, Jonathan Less, and Lester A. Zeager, “Improving the Supplemental Poverty Measure: Two Proposals,” unpublished manuscript available from the authors, Department of Economics, East Carolina University, Greenville, NC, March 8, 2017.

Bureau of Labor Statistics (BLS), Division of Price and Index Number Research, PINR Experimental Poverty Measures, <http://stats.bls.gov/pir/spmhome.htm>, 2017.

Census Bureau (Census), “American Community Survey and Puerto Rico Community Survey 2016 Subject Definitions, https://www2.census.gov/programs-surveys/acs/tech_docs/subject_definitions/2016_ACSSubjectDefinitions.pdf.

Citro, Connie F. and Robert T. Michael (eds.), *Measuring Poverty: A New Approach*, National Academy of Sciences, Washington, DC, 1995.

Figueroa, Eric, Bureau of Economic Analysis, unpublished “results of 1st Stage rents RPPs for 2015 and 2015 for the 38 metropolitan and urban areas of the U.S. using the CPI housing sample,” email communication, September 21, 2017.

Fox, Liana, “The Supplemental Poverty Measure: 2016,” *Current Population Reports*, P60-261, U.S. Census Bureau, available at <https://www.census.gov/content/dam/Census/library/publications/2017/demo/p60-261.pdf> , September 2017.

Interagency Technical Working Group (ITWG), “Observations from the Interagency Technical Working Group on Developing a Supplemental Poverty Measure,” available at <http://stats.bls.gov/pir/spmhome.htm>, 2010.

Kingkade, W. Ward, “What are Housing Assistance Support Recipients Reporting as Rent?” SEHSD Working Paper 2017-44, 9/12/2017, <https://www.census.gov/content/dam/Census/library/working-papers/2017/demo/SEHSD-WP2017-44.pdf> .

Martin, Troy, Bettina Aten, and Eric Figueroa, “Estimating the Price of Rents in Regional Price Parities,” manuscript from the Bureau of Economic Analysis, Department of Commerce, 2011, https://www.bea.gov/papers/pdf/Estimating_Price_Rents_Regional_Price_Parities.pdf

Penrose, Jessica, BLS, “regarding questions about rents in the CPI data base used by BEA--three more questions,” email communication, October 26, 2017.

Renwick, Trudi J., “Geographic Adjustments of Supplemental Poverty Measure Thresholds: Using the American Community Survey Five-Year Data on Housing Costs,” paper presented at the July 2011 Western Economic Association, San Diego, CA, available from Census Bureau working papers, 2011a.

Renwick, Trudi, “Geographic Adjustments for SPM Poverty Thresholds,” presented at the Annual Meeting of the Allied Social Science Associations (ASSA), Society of Government Economists Session (SGE), Denver, Colorado. Poverty Measurement Working Paper, U.S. Census Bureau, 2011b.

Renwick, Trudi J., unpublished poverty rates for 2014 based on SPM thresholds produced in this study along with CPS data and SPM resource measure, December 1, 2017.

Renwick, Trudi J., Eric B. Figueroa, and Bettina H. Aten, “Supplemental Poverty Measure: A Comparison of Geographic Adjustments with Regional Price Parities vs. Median Rents from the American Community Survey,” available from Census Bureau working papers, March 2014.

Renwick, Trudi J., Eric B. Figueroa, and Bettina H. Aten, “Supplemental Poverty Measure: A Comparison of Geographic Adjustments with Regional Price Parities vs. Median Rents from the American Community Survey: An Update,” SEHSD Working Paper Number 2017-36, <https://www.census.gov/content/dam/Census/library/working-papers/2017/demo/SEHSD-WP2017-36.pdf> .

Short, Kathleen, “The Research Supplemental Poverty Measure: 2010,” *Current Population Reports*, P60-241, U.S. Census Bureau, available at www.census.gov/content/dam/Census/library/publications/2011/demo/p60-241.pdf , November 2011.

Short, Kathleen, "Where We Live: Geographic Differences in Poverty Thresholds," United States Bureau of the Census, paper presented at the Annual Meeting of the Society of Government Economists, New Orleans, LA, 2001.

Table 1. Areas for Which Quality-Adjusted Normalized Prices Are Produced

Area	Area Description
<i>In CPI Housing Survey Sample and CE Sample</i>	
A102	Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD
A103	Boston-Brockton-Nashua, MA-NH-ME-CT
A104	Pittsburgh, PA
A109	New York City
A110	New York-Connecticut Suburbs
A111	New Jersey-Pennsylvania Suburbs
A207	Chicago-Gary-Kenosha, IL-IN-WI
A208	Detroit-Ann Arbor-Flint, MI
A209	St. Louis-East St. Louis-Alton, MO-IL
A210	Cleveland-Akron, OH
A211	Minneapolis-St. Paul, MN-WI
A212	Milwaukee-Racine, WI
A213	Cincinnati-Hamilton, OH-KY-IN
A214	Kansas City, MO-KS
A312	Washington, DC-MD-VA-WV
A313	Baltimore, MD
A316	Dallas-Fort Worth, TX
A318	Houston-Galveston-Brazoria, TX
A319	Atlanta, GA
A320	Miami-Fort Lauderdale, FL
A321	Tampa-St. Petersburg-Clearwater, FL
A419	Los Angeles-Long Beach, CA
A420	Los Angeles Suburbs, CA
A422	San Francisco-Oakland-San Jose, CA
A423	Seattle-Tacoma-Bremerton, WA
A424	San Diego, CA
A425	Portland-Salem, OR-WA
A426	Honolulu, HI
A427	Anchorage, AK
A429	Phoenix-Mesa, AZ
A433	Denver-Boulder-Greeley, CO
D200	Midwest nonmetropolitan urban
D300	South nonmetropolitan urban
D400	West nonmetropolitan urban
X100	Northeast small metropolitan
X200	Midwest small metropolitan
X300	South small metropolitan
X499	West small metropolitan
<i>In CE Sample Only</i>	
R100	Northeast rural
R200	Midwest rural
R300	South rural
R400	West rural