A Decade of Experimental Poverty Thresholds 1990 to 2000

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Introduction

This paper describes the poverty thresholds that are being used by the Census Bureau in research regarding experimental measures of poverty. These thresholds are based on recommendations from the National Academy Sciences (NAS) Panel on Poverty and Family Assistance that published a report with specific recommendations in 1995. In that report, *Measuring Poverty, A New Approach*[1], the NAS Panel recommended that the current official measure of poverty should be revised.

> *Overall, except for the minor changes in the number of different thresholds and the change in the price index for updating them, the poverty line has not been altered since it was first adopted in 1965. In the language of poverty measurement, the United States has an "absolute" poverty threshold that is updated for price changes but not for real growth in consumption. Thus, the poverty line no longer represents the concept on which it was originally based—namely, food times a food share multiplier—because that share will change (and has changed) with rising living standards. Rather, the poverty threshold reflects in today's dollars the line that was set some 30 years ago.*[2]

> *When the official poverty measure was first developed for 1963, the threshold of about $3,100 for a four-person family represented about one-half median after-tax four-person family income (see Vaughan, 1993). Between 1963 and 1992, median after-tax four-person family income increased by 28 percent in real terms, but the thresholds remained constant. Families' total expenditures also increased in real terms, and spending on nonfood items rose more rapidly than spending on food: expenditures on food accounted for one-third of the total in the 1950s but less than one-sixth of the total in the 1990s (see Bureau of the Census, 1993d:Table 708). Hence, if the original approach were used to develop the poverty thresholds today, their value would be significantly higher.*[3]

That Panel of experts recommended a new way to calculate poverty thresholds that would, by design, be updated on a continuous basis and reflect changes in levels of spending on basic goods over time. Since the release of that report detailing these recommendations, the Census Bureau and the BLS have collaborated in calculating these thresholds in a series of papers and reports.[4] This paper presents a discussion of each of the elements of the experimental thresholds as the NAS Panel recommendations have been used in research at the Census Bureau and the BLS. The paper presents experimental thresholds that have been prepared for the period from 1990 to 2000. These thresholds are examined over time and used to compare resulting poverty statistics to the current official measures. This paper summarizes what we know about these thresholds now. It includes discussion of conceptual and theoretical issues which underlie the NAS Panel's approach to poverty threshold construction. Some themes that keep coming up are the

[1] Citro and Michael, 1995, p. 102-103.
[2] Op cit. p 25.

difference among needs, consumption, and expenditure, the treatment of health care and owner-occupied housing, the ease of computation, and the effect of changes over time in various elements of the poverty threshold.

A. Poverty Thresholds: The Concept

The NAS Panel that recommended a new measure of poverty placed importance on creating a poverty threshold that would maintain a relationship to the overall standard of living in the nation over time. The Panel's report states that, " *The major reason, in our view, to revise the threshold concept for the U.S. poverty measure is its implications for updating the thresholds over time."* The NAS Panel recommended that the poverty thresholds, once determined, would be updated over time using the change in expenditures at the median for a basic set of goods made by a specified reference family. Specifically, their recommendations were:

> **Recommendation 2.1** A poverty threshold with which to initiate a new series of official U.S. poverty statistics should be derived from Consumer Expenditure Survey data for a reference family of four persons (two adults and two children). The procedure should be to specify a percentage of median annual expenditures for such families on the sum of three basic goods and services—food, clothing, and shelter (including utilities)—and apply a specified multiplier to the corresponding dollar level so as to add a small amount for other needs.
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> **Recommendation 2.2** The new poverty thresholds should be updated each year to reflect changes in consumption of the basic goods and services contained in the poverty budget: determine the dollar value that represents the designated percentage of the median level of expenditures on the sum of food, clothing, and shelter for two-adult-two-child families and apply the designated multiplier. To smooth out year-to-year fluctuations and to lag the adjustment to some extent, perform the calculations for each year by averaging the most recent 3 years' worth of data from the Consumer Expenditure Survey, with the data for each of those years brought forward to the current period by using the change in the Consumer Price Index.

The procedure for creating a time series of thresholds under the Panel's concept is to select a percentage of median expenditures for food, clothing, and shelter (the basic set of goods) and a multiplier for the base year. The Panel stated that the "...food, clothing, and shelter [including utilities] component of the reference family poverty threshold under the proposed concept must be expressed as a percentage of median expenditures on these categories."[5] A multiplier would be applied to the food, clothing, and shelter

[3] Op cit. p. 30.
[4] See, for example, Garner et al., 1998, Short et al., 1999 and Short, 2001a.
[5] Citro and Michael, 1995, p. 148.

(including utilities) component of the poverty threshold so as to allow a small fraction for other needed expenditures. With this information, a base year threshold would be established first, then the same percentage and multiplier would be used to produce the thresholds for other years. Thus, the only requirement to update thresholds for each year would be the estimation of median expenditures for food, clothing, shelter, and utilities. With reference to the actual calculation of poverty thresholds, the Panel stated generally that: [6]

- The poverty thresholds should represent a budget for food, clothing, shelter (including utilities), and a small additional amount to allow for other needs (e.g., household supplies, personal care, and non-work-related transportation).
- A threshold for a reference family type should be developed using actual consumer expenditure survey data and updated annually to reflect changes in expenditures in food, clothing, and shelter over the previous 3 years.
- The reference family threshold should be adjusted to reflect the needs of different family types and to reflect geographic differences in housing costs.

The general formula for deriving the proposed reference family threshold is shown in (1).

$$T_{FCSU} = \frac{(M_1 * P_1 * E_m) + (M_2 * P_2 * E_m)}{2} \qquad (1)$$

where T_{FCSU} =threshold based on food, clothing, shelter, and utilities expenditures (FCSU)
M_1 = multiplier for smaller additional amount – 1.15
M_2 = multiplier for larger additional amount – 1.25
P_1 = lower percentage of expenditures for FCSU – 78%
P_2 = higher percentage of expenditures for FCSU – 83%
E_m = median expenditures.

This formula calculates the midpoint of the threshold using the lowest of the two recommended ranges (M1 * P1) and the threshold using the highest of the ranges (M2 * P2). This calculation results in a threshold that is obtained by multiplying .96725 times the median.

B. Poverty Thresholds: the Elements

1. Reference family. Following this procedure then, calculation of the poverty thresholds begins with the choice of a reference family for whom an estimate of median expenditures is obtained. The reference

[6] Citro and Michael, pp. 4-5.

family chosen by the Panel was one including two adults and two children.[7] The criteria used to select the family type was that the reference family would "fall near the center of the family size distribution rather than at one of the extremes…also, it is preferable for the reference family to be one that accounts for a relatively large proportion of the population because its spending patterns observed in a sample survey will be the basis for the poverty threshold…"[8] . Selection of a reference family that typifies the spending patterns of all family types, however, is not possible. Based on the 1998 quarter two through 2001 quarter one CE data, about 9 percent of all families used in our calculations are two-adult/two-child families **(Figure 1)**. Of the approximately 85,000 families in this 3 –year sample, 7,668 are reference families. By far, the largest group consists of unrelated individuals or single-person families, comprising 32 percent of all families, followed by two-adult families with no children – 25 percent. Of families with children, those with two adults and two children are the largest group, followed closely by those with two adults and one child. Since children make up a large portion of the poverty population it is reasonable that the reference family represent spending patterns for that group.

This last point is an important one, however, since the method used here implicitly assumes that the allocation of total expenditures for the basic bundle do not vary by family type. Only the overall dollar amount is allocated to other family types by use of an equivalence scale. This can be a relatively clumsy mechanism by which to characterize different needs, particularly for shelter. For example, based on CE data, young families with children tend to own the homes that they live in and to have relatively large home mortgages. Their out-of-pocket expenses for housing tend to be large and to comprise a larger portion of expenses than those of elderly people who are likely to own their home without debt. Use of an equivalence scale to calculate thresholds for these families, unless it includes adjustments for age and home ownership, will not account for these differences.

A more salient point is that the proportion of the threshold that is spent for housing by the reference family is estimated and used in the application of geographic indexes which are based on housing costs. This issue

[7] For the Panel's report, the reference family was specifically defined as including a married couple with two of their own children (Citro and Michael, p. 44-45).
[8] Citro and Michael, p. 101.

will be discussed later in more detail with the geographic adjustments. It also applies to the estimation of family resources when valuing housing subsidies. Suffice it to say at this point, that this proportion varies across family types and over time for each family. For example, for the reference family, shelter and utilities together made up 45 percent of FCSU threshold in 2000, up from 41 percent in 1990. Single person families spent about 49 percent of an FCSU threshold for these housing costs in 2000.

Another issue that the Panel indicated needed more research is the treatment of health care in the proposed poverty measure. One option, but not the one that the Panel followed, includes health care among the items in the commodity set for the threshold estimation. **Figure 2** shows the average allocation of quarterly expenditures at the 30^{th} and 35^{th} percentiles for the reference family of two adults and two children on the expanded set of commodities in the year 2000. These commodities include food, clothing, shelter, utilities, and health care (FCSUM). The chart shows that the reference family spent more than the other family types shown here than the other, generally smaller families. **Table 2** reveals that, for the reference family, 34 percent of FCSUM spending was for food, 34 percent for shelter, 16 percent for utilities, and 8 percent for each of clothing and medical care. Of the other family types of interest, single parent families spent proportionally more on utilities and less on health care than the reference family, and elderly families spent a much larger proportion on health care and a considerably smaller proportion for shelter. The pattern for singles reflects the pattern of the elderly, since many elderly individuals are in this category.

Another consideration in the choice of reference family are the ramifications of the choice of reference family over time. Choice of the reference family, and how spending patterns of this family type change over time, has implications for experimental thresholds. Considering this issue, Bavier (2000) examined estimated expenditures of different family types from 1972 to 1994. He found important differences in how spending on basics by family type changed over time. Over this long period of time he found that, after adjusting for inflation, aged couples saw a larger percent increase in their spending on basics than the reference family, whereas, single parent families with two children and one-adult households had much lower increases.

Figure 3 shows the median expenditures on FCSU for different family types from 1990 to 2000. These values are in current year dollars (e.g., the 1990 FCSU expenditures are in 1990 while the 1991 expenditures are in 1991 dollars. The family types shown only vary by combinations of number of adults and children and not by age. Overall, we see that patterns are similar with only slight differences for the family types shown. Admittedly, we may see differences had we examined the specific family groups that Bavier examined. **Table 3** shows the percent change in median FCSU expenditures across the decade by various family types. For our reference family, FCSU spending increased about 33 percent over the period. Spending increased less for some family types -- those with no children, and large families with 3 adults and children. On the other hand, median spending on the FCSU bundle increased more for families with only one adult with children across the same period; rising 39 percent for families with one parent and two children.

Finally, spending patterns for a given family type may change over time. **Figure 4a** shows that the shares of thresholds on the individual elements of FCSUM changed for the reference family from 1990 to 2000. The chart shows that there was an increase in the percent spent for shelter, from 24 to 28 percent, while the percent spent on other items decreased slightly over the decade or stayed the same.

Figure 4b shows changes from 1990 to 2000 for one-person families (specifically reference persons living without relatives). This group shows a slightly different trend over the period. They exhibit small increases in the proportion spent on shelter, utilities, and health care, and declines in proportions spent on food and clothing. So that, overall, we do see differences in the changes of patterns of spending on basic goods, but those changes are not large for each family type. Overall, an examination of the Panel's choice of reference family seems a reasonable one. Across the decade, FCSUM spending increased similarly as other family types and patterns of spending over the period changed only slightly.

2. Median expenditures. Once the reference family is chosen, median expenditures for a specified group of basic goods are calculated. As noted above, the Panel specified this group of basic commodities to include food, clothing, shelter (including utilities), and a small additional amount to allow for other needs

(e.g., household supplies, personal care, and non-work-related transportation). Expenditures are defined as in official CE publications. Expenditures are the transaction costs, including excise and sales taxes, for these commodities acquired during the interview period (BLS 2001).

One important item that was not included in the Panel's description of basic expenditures was spending for health care. The NAS Panel was aware that expenditures for health care can be a significant portion of a family's budget and have become an increasingly larger budget item since the 1960s. The Panel considered including health care in the thresholds with food, clothing, and shelter needs, but decided against it. They argued that medical care needs, or spending, differ from that for food or housing in that not every family requires medical care in a given year, but when they do, the associated costs may be extraordinarily large. They concluded that it would be impossible to capture the actual variation of medical needs by variations in the thresholds and that this could lead to what the Panel termed "erroneous poverty classification." Instead, they developed a method that was intended to represent "actual" medical out-of-pocket (MOOP) spending. These expenses should include the payment of health insurance premiums plus other medically necessary items such as prescription drugs and doctor co-payments that are not paid for by insurance. Subtracting these "actual" amounts from income, like taxes and work expenses, leaves the amount of income that the family had available in 1999 to purchase the threshold bundle of goods, FCSU and a "little bit more'.

Since including medical out-of-pocket expenses (MOOP) in a poverty measure at all became a complex statistical computation[9], an argument was made to include medical expenses in thresholds, as noted earlier. If a small number of thresholds could be provided that took account of health care needs, then these thresholds could be used by researchers outside the Census Bureau with other types of survey data. Portability of a poverty measure is an important consideration in the framework of an official poverty measure that can be used across programs. In response to this debate several sets of experimental poverty measures have been developed that incorporate medical expenses in the thresholds (see Banthin, et al., 2001, Bavier 2001, Short 2001a).

[9] See Betson, 2001, and Short, 2001a.

Again, the selection of the median basic bundle has implications over time. The Panel intended to use an adjustment factor that would be a "quasi-relative" updating mechanism. The Panel expected that the median basic bundle, FCSU expenditures by the reference family, would change at a different rate than inflation but by less than the change in consumption as measured by per capita Personal Consumption Expenditures (PCE) from the National Income and Product Accounts.[10]

Figure 5 compares median FCSU expenditures for the reference two-adult/two-child household, the all item CPI-U, per capita PCE, and median before-tax household income for a four-person family. The chart uses 1990 as the base year and plots values over the decade. As shown, PCE increases faster than median income or FCSU expenditures, which increase faster than the CPI-U. These results seem to confirm the Panel's expectations regarding the use of the median FCSU as an updating mechanism changing less than total consumption[11], though this bundle appears to be tracking changes in prices, as measured by the CPI-U, quite closely.

Experimental poverty thresholds that are calculated and updated every year using survey data may exhibit more variation from year to year than the current official thresholds, which are updated using the CPI-U. This variability may have important ramifications on the use of these thresholds over time. After the Panel published their report, concern was raised that the Panel's proposed updating method would be highly volatile and would have a large variance, especially when compared to the variance of the change in the CPI-U. Preliminary calculations of standard errors for the medians are used to compute confidence intervals, shown in the chart and in **Table 5.**

The Panel recommended that the thresholds be updated annually using an average of the most recent three years of CE data. The three-year average approach was recommended to increase the sample size and also to smooth out year-to-year changes in the thresholds; however this approach produces thresholds that lag behind changes in real consumption.[12] Further, the calculations are made using three years of quarterly

[10] For more discussion see Johnson et al., 1997, pp. 28-37.
[11] Actually, PCE includes some items not typically thought of as personal consumption, such as expenditures on behalf of households by third parties, the military etc.
[12] Citro and Michael, 1995, Table 2-7, p. 156.

data, where the quarterly CE observations are treated as though they are independent samples. Preliminary calculation of variances for medians are thus conservative, in the sense that correlation between quarters is not taken into account.

It should be noted that, in the construction of the thresholds, *out-of-pocket expenditures* are used. However, the mechanism to define and update the thresholds was to be based on changes in *consumption* of basic goods (Recommendation 2.2). Out-of-pocket expenditures for food and utilities are likely to represent the value of consumption of these items since food and fuel are most often consumed near the time of purchase. The consumption of rental housing also is likely to be fairly well represented by rental expenditures. Such expenditures are less likely to represent the consumption of clothing. Further, out-of-pocket expenditure for owner-occupied housing is not likely to be a good proxy for consumption. For example, if most housing were owner-occupied and the owners had low or no mortgages so that monthly outlays were small, the expenditure approach would imply that these owners have no or little consumption of housing.

If the NAS Panel were attempting to provide a threshold based on the cost of consumption, the out-of-pocket expenditure approach would not be a good model to follow. If the cost of consumption approach were preferred, the implicit cost of owned housing would need to be accounted for in the measure. The Panel acknowledged this by stating that their approach was used for processing convenience only. If on the other hand, the purpose of the thresholds were to provide an estimate of the expenditure that was needed to meet the basic *spending /expenditure* needs of the family in a given reference period, then the out-of-pocket approach would be appropriate. [13]

Another area where the discrepancy between concepts of consumption versus expenditures arises is that of health care. Health care expenditures are often regular, insofar as they take the form of insurance premiums. The consumption of health care, on the other hand, can be episodic, occurring in unpredictable ways that often require large expenditures. If the purpose of a poverty threshold is to measure how many families last year were unable to afford to pay for their basic needs, then we want to know the amount of

money they actually spent on health care. If the thresholds are meant to measure, on average, what families are expected to need then an expected value of MOOP is more appropriate.

In the Panel's report the terms expenditures, consumption, and needs are often used interchangeably. However these concepts are not the same. This distinction causes difficulty for several components of the measure, including the treatment of shelter and health care needs. The main question to be asked is, what does the threshold measure? Does it measure what a family needs? Are needs represented by what a family *consumes* or what they *spent to consume* that commodity? Should it take account of the fact that consumption may not occur in the same period of time as payment, such as in the case of people who own their own homes without debt and thus report very low shelter costs? Should it include an expected amount of health care or take account of the fact that, in spite of expectations, some families face catastrophic health care costs, while the vast majority require few health care services in a given year? And do the experimental thresholds, that we use in our current research, which measure essentially what families spend in any year for these basic goods, adequately proxy what families need?

3. Percent of median. In setting the initial threshold, the NAS Panel considered using a percentage of the median expenditures on basics by the reference family. The percentages of the median were selected which correspond to the reference family's expenditures between the 30th and 35th percentiles of the distribution of FCSU expenditures. The NAS Panel reviewed other recent budget studies to judge a 'reasonable range' for basic goods. Citing Renwick (1993) and Schwarz and Volgy (1992) they settled on the 30th and 35th percentile of the 1989-91 expenditure distribution. These percentiles translated to 78 and 83 percent of the median for 1992 estimates available to the Panel. They concluded in their study that these percentiles seem to represent a "reasonable range" for the FCSU component of the reference family's threshold.

> *The designation of a percentile value for food, clothing and shelter—which, when expressed as a constant percentage of the median, will drive the poverty thresholds in future years—is obviously a matter of judgment. We do not recommend a specific value or even a range; we do, however, conclude that a reasonable range for the food, clothing, and shelter component of the reference family threshold would be from the 30th to the 35th percentile, or from 78 to 83 percent of the median. In 1992 dollars, this range is from $11,950 to $12,719.*[14]

[13] See Garner and Short 2001.
[14] Citro and Michael, 1995, p. 149.

Calculation of these percentiles at a later time period suggests a stable relationship between the percentiles that the Panel had in mind as the relevant percentage of the median that it translated to in their 1992 estimates. In a paper examining the measurement of shelter costs in experimental thresholds, Garner and Rozaklis (2001) reexamined the distribution of the estimated thresholds for the period from 1995 to 1997. They computed the average of expenditures in the 27.5 to 32.5 percentile as an approximation to the 30th percentile, and expenditures between the 32.5 and the 37.5 percentile to approximate the 35th percentile. They then re-estimated percentages of the medians corresponding to these percentiles. The re-estimated percentages were only slightly higher, 79 to 84 percent, for all three years examined.

In subsequent work, rather than selecting a specific percentage or estimating a range of values for experimental thresholds, our applications have used the midpoint of the recommended range, in combination with the range of multipliers below, to set the value of the thresholds. This selection has met with little controversy and seems a reasonable choice. The use of the percentage (96.725 percent) simplifies the updating mechanism over time and ties upgrades to changes in expenditures at the median rather than those below the median.

4. Multipliers. Once the percent of median expenditures on a basic bundle has been estimated then multipliers were applied to the basic bundle to add a small additional amount to allow for other needs, such as housekeeping supplies, personal care, and non work-related transportation. As noted earlier, multipliers were applied to the value of the designated basic bundle (reflected as some percentage of the median of the basic bundle) to account for the additional costs of other needed commodities. The two groups of commodities considered by the Panel reflect expenditures for the: (1) basic bundle plus those for personal care and one-half of transportation;[15] and (2) basic bundle plus personal care, one-half transportation, education, and reading materials costs.[16] In the report, the Panel stated that "we arbitrarily chose to exclude

[15] ***Transportation*** expenditures were defined by the Panel to include vehicle finance charges, expenses for gasoline and motor oil, maintenance and repairs, vehicle insurance, public transportation (including air fares), and vehicle rentals, licenses and other charges. In addition, transportation included the total purchase price (minus the trade-in value) on new and used vehicles.
Personal care includes products for hair, oral hygiene, and shaving, cosmetics and bath products, electric personal care appliances, other personal care products, and personal care services.

[16] ***Education*** includes tuition, fees, textbooks, supplies and equipment for public and private nursery schools, elementary, and high schools, colleges, and universities, and others schools

one-half of transportation costs because the Interview Survey does not distinguish between work expenses, which we propose to deduct from resources, and personal transportation for errands, vacations, etc."[17] This allocation is consistent with other studies.[18]

The Panel's determination of what to include in the additional amount was constrained by what was available in the CE Interview Survey (e.g., some personal care items and household supplies, which would seem natural candidates to include in the multiplier bundle, are only available from the CE Diary). However, a more salient point is that the Panel did not intend to engage in a detailed budget-building exercise; they proposed some reasonable multipliers to illustrate a group of goods that would be represented by a small multiplier which would be applied to a basic bundle.

> *However, to try to develop a detailed list seems an exercise in futility and likely to raise needless controversy. A good compromise, we concluded, is to specify a bundle of food, clothing and shelter (including utilities) and apply a small, fixed multiple for other needed spending, such as personal care, household supplies, and non-work-related transportation."*[19]

The Panel concluded from a review of their tabulations that a reasonable range for the multiplier was 1.15 to 1.25, which allowed for a poverty threshold that ranged from $13,700 to $15,900 (in 1992 dollars rounded). The lower value is 78 percent of median expenditures for the basic bundle (corresponding to the 30^{th} percentile) times 1.15 and the upper value is 83 percent of the median for the basic bundle (corresponding to the 35^{th} percentile) times 1.25. The Panel chose their multipliers as corresponding to those at or below the median level of expenditures for the basic bundle.

Subsequent work by BLS and the Census Bureau examined the selection of multipliers and judged them to be a reasonable range.[20] In their work on shelter costs, Garner and Rozaklis (2001) also examined the multipliers for the time period from 1995 to 1997. They recalculated multipliers as the average of the of the

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Reading materials includes subscriptions for newspapers, magazines, and books through book clubs, purchase of single copy newspapers, and magazines, newsletters, books, encyclopedias, and other reference books.

[17] Citro and Michael, 1995, p. 151.

[18] In constructing the cost of raising a child, the Department of Agriculture used data from a 1990 study by the Department of Transportation which found that employment-related transportation activities account for about 40 percent of travel costs for families with children. See *Expenditures on Children by Families, 1995 Annual Report*, Center for Nutrition Policy and Promotion, USDA, page 5, and U.S. Department of Transportation, Federal Highway Administration, 1994, *1990 Nationwide Personal Transportation Study.*

[19] Citro and Michael, p. 143.

[20] Garner et al., 1998.

multipliers at the 30th and the 35th percentiles for a budget composed of expenditures for food, clothing, housing, utilities, one-half of out-of-pocket transportation expenditures, and expenditures for personal care and a larger budget that also included expenditures for education and reading materials. There recalculated multipliers for 1995 were 1.20 to 1.22 and for 1996 and 1997, 1.20 to 1.23, all within the recommended range of 1.15 to 1.25.

An important point to remember in the calculation of thresholds, then, is that the original specification of the multipliers depended on the notion that the median basic bundle is defined for food, clothing, and shelter expenses. If other items are included, such as health care expenses, then the multipliers should be recalculated to re-achieve a particular range to be applied to the median.

In all work done more recently, particularly in the two Census Bureau reports, the midpoint of the upper and lower bound of the recommended range has been used to set the experimental threshold. This has proved to be both a useful compromise and one that has not been controversial.

5. Equivalence scales. Thresholds for family types other than the reference family of two adults and two children are derived by applying an equivalence scale to reflect differences in family composition and needs. Equivalence scale adjustments are made to the reference family's threshold to account for the differing needs of adults and children and the economies of scale of living in larger families. After evaluating the equivalence scale implicit in the poverty thresholds and several forms of the thresholds, the Panel recommended a scale of the type shown in (2).

$$\text{Scale value} = (A + PK)^F \qquad (2)$$

where A = the number of adults in the family,
K = the number of children, each of whom is treated as a proportion (P) of an adult, and
F = the scale economy factor.

Specifically, the Panel recommended that P be set at 0.70 such that the needs of children are treated as 70 percent of those of an adult, and the scale economy factor, F, be set in the range of 0.65 to 0.75.

Subsequent to publication of the Panel's report, Betson (1996) reviewed the implications of the selection of the two-parameter scale. Examining the equivalence scales implicit in the current official thresholds, Betson used a smoothing formula as an approximation. He uses a formula with three parameters,

$$S(A,K) = (1 + a(A-1) + PK)^F \qquad (3)$$

Where *a* represents the needs of secondary adults relative to a single adult, *P* represents the relative needs of children relative to the single adults, and *F* represents the economies of scale in consumption or the elasticity of family needs to the number of equivalent adults in the family.

Comparing resulting estimates to the cost of children literature, Betson concluded that these scales understated the relative spending on children relative to adults. Smoothing the current scales did not rectify the problem and even widened the gap. Assumptions were required to adequately reflect the needs of childless couples relative to the needs of single adults as well. This led Betson to specify a three parameter scale, shown in (4).

Three-parameter Scale $= (A + .8 + .5*K-1))^{.7}$ for single parents
$= (A + .5*K)^{.7}$ otherwise (4)
and the ratio of the scale for 2 adults to one adult is 1.41.

Some consensus has evolved around this scale (see Open Letter, 2000) and it has now been incorporated in many of the experimental measures published in the Census Bureau reports. Nevertheless, as Betson pointed out in his concluding remarks, "…it is impossible to identify a set of scales based solely upon the observed behavior of households, additional assumptions have to be made which can not be verified." (Betson, 1996, p. 37).

The Panel's work, and subsequent study by Betson, focused on thresholds that included food, clothing, shelter, utilities, and a bit more: FCSU thresholds. They examined changes in spending patterns on these items across differently composed families. Should that bundle of basic goods change to include other items such as health care, then the differences among family types may also change.

This is illustrated by our applications that have added MOOP to the thresholds, whereby we calculate additional 'medical' equivalence scales, or medical risk factors. These indexes are based on data from the

1996 Medical Expenditure Panel Survey and adjust health care expenditures for the reference family for other family types. These other families are defined in terms of the presence of elderly people in the family, health insurance coverage, self-reported health status for family members, and family sizes (see Banthin et al., 2001). The characteristics selected are assumed to be correlated with MOOP and thus it is reasonable to use them in the calculation of medical equivalence scales. Nevertheless, the resulting outcome is a large number of poverty thresholds based on, not only number of adults and children, but also on age of family members, health insurance coverage, and health of family members (see Banthin et al, 2001, Short, 2001, or Short and Garner, 2002 for details on medical risk factors).

Other work has examined equivalence scales related to experimental poverty thresholds. Work done by Garner and Short (2001) have looked at thresholds that substitute a rental equivalence approach to valuing shelter costs rather than the Panel's method. These findings suggest that when shelter costs represent consumption of housing rather than expenditure of housing, there are greater economies of scale evidenced for larger families.

Additional evidence of greater economies of scale are seen when subjective poverty thresholds are examined. These thresholds are computed using responses to questions in household surveys about how much a family needs to spend or how much income a family needs to get along. Using data from the Survey of Income and Program Participation (SIPP), Garner and Short (2002) found that equivalence scales constructed using these data illustrate greater economies of scale for larger families as well. Others calculating similarly based thresholds have also noted that poverty thresholds that are not based on food consumption, such as the current official thresholds, exhibit greater economies of scale in general (Danziger et al. 1984). Obviously, equivalence scales based on mathematical formulas represent a simplification of consumption patterns and may not precisely replicate observed patterns. On the other hand, equivalence scales estimated from observed behavior may be contaminated by consumption constraints that are not completely accounted for, such as observed medical spending by the uninsured. Use of the 3-parameter scale seems to be a reasonable compromise when the focus is the lower end of the

economic well-being distribution. As many welfare and related transfer programs and policies are directed at this population, the 3-parameter scale has gained a consensus among a wide group of researchers.

6. Geographic indexes. Once the value for the basic bundle is determined and an equivalence scale selected, the NAS Panel recommended that the thresholds be adjusted to reflect geographic differences in the price of housing. While noting that an index including all items, or an FCSU index would be best, the Panel used what was available. Since housing costs made up 44 percent of the poverty threshold calculated by the NAS Panel for 1992, they constructed a housing price adjustment only. Inter-area housing price indexes, calculated from the 1990 Census data on gross rent for apartments with specified characteristics, adjusted to reflect the share of housing in the proposed poverty budget, were used by the Panel.[21]

These thresholds were then adjusted to account for differences in the cost of housing in metropolitan and non-metropolitan areas in the country using data from the 1990 Census. The Panel used a modified version of the Department of Housing and Urban Development (HUD) methodology for developing Fair Market Rents[22] (FMRs) to produce interarea housing price index values. Index values were produced for metropolitan areas in six population size categories within each of the nine Census regions and for non-metropolitan areas (not distinguished by size) in each of the regions.[23]

Subsequent work by Short (2000) examined the indexes and found some difficulties, primarily the aggregation of geographic areas into Census Divisions. There are nine Census Divisions and each represents a group of geographically contiguous states that may or may not contain similar housing markets. Assuming that housing costs were similar within each division was not correct for some areas, such as the New England division. This resulted in the estimation of high poverty rates for some states that seemed implausible.

[21] For a description of the housing adjustment, see Citro and Michael, 1995, pp. 194-199, 249, 252-253.
[22] Fair Market Rents are used by HUD to administer the Section 8 Housing Program.
[23] Citro and Michael, 1995, pp.194-199.

Short recalculated geographic indexes using information on rents used by the Department of Housing and Urban Development to administer a housing program that serves low-income families, FMRs. These data were used to construct an index for smaller geographic areas, specifically for metropolitan areas and nonmetropolitan areas for each state. This disaggregation allowed more accurate calculation of housing costs for smaller areas and thus resulted in more reasonable poverty rates for states.

Calculating interarea cost of living indexes is difficult. As noted above, there is little information available for this purpose. The use of Fair Market Rents is not without controversy. Calculated by the Department of Housing and Urban Development, there are serious shortcomings with these data. [24] They are used in this work primarily in an experimental sense, to begin to understand the implications of geographically adjusting poverty thresholds and to gain an understanding of the data that would be required to make more precise adjustments.

As mentioned earlier, however, the choice of reference family has repercussions on the application of geographic indexes. Since in 1992 housing costs were 44 percent of the FCSU threshold, a fixed weight index is calculated using this figure. As we have seen above, however, this percentage differs by family type and also, for the reference family over time. Since the proportion spent on housing for single person families is higher than that for the reference family, poverty thresholds adjusted for high housing costs are possibly underestimating the income needed for singles relative to the reference family.

The area of geographic adjusting poverty thresholds is one that requires additional work. However, as pointed out by Ruggles in her book "Drawing the Line", "…a strong case can be made for adjustment of the poverty thresholds for price differences by geographic area and that, even though we cannot make precise adjustments for very small areas, we quite possibly would make fewer errors if reasonable adjustments were made for larger geographic areas."[25]

C. Data and Calculations

[24] See Short, 2001a for a discussion.

Table 6 shows experimental poverty thresholds that have been calculated for the period from 1990 to 2000 in the manner described above. First, median expenditures (adjusted to current threshold year dollars) for reference units were obtained using their FCSU expenditures. Weighted expenditure data from the 1988 quarter 2 through 2001 quarter 1 Consumer Expenditure (CE) Interview Survey were used to produce the poverty thresholds presented in the Census Bureau reports.[26] Expenditures for a basic bundle of commodities composed of food, clothing, shelter, and utilities[27] were obtained from the CE data for a reference family type consisting of two adults and two children. Up until 1999 quarter 1, approximately 5500 consumer units[28] were interviewed using the CE Interview Survey. Beginning with 1999 quarter 1, the sample increased to about 7,500 per quarter. Of these approximately nine percent are the reference family.

In the calculations we have used a family as the unit of analysis rather than the consumer unit. We used the Census definition of family that includes all individuals living at the same address related by blood, marriage, or adoption. Many agree that an appropriate unit of analysis might be a household. All of the estimates reported here would differ somewhat if that unit were used rather than family.[29]

Expenditures include those for gifts, but exclude the value of gifts received, other in-kind transfers received except for the cash value of food stamps, own production for own consumption and the purchases or portions of purchases directly attributable to business purposes. Also excluded are periodic credit or installment payments on commodities already acquired. For owned housing, neither the purchase price of

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[25] Ruggles, 1990, p. 84.

[26] There is also a diary portion to the CE. The diary and the interview samples are entirely independent so that expenditures from the two cannot be combined.

[27] The basic bundle is composed of food, apparel, shelter, and utilities, which are defined as follows:

Food includes food purchased for home use and away, and excludes alcohol and tobacco and other non-food items purchased at grocery stores.

Clothing includes expenditures for all types of clothing including uniforms and sewing materials.

Shelter includes rent, and for homeowners, mortgage interest (shelter does not include principal payment) taxes, maintenance and repairs.

Utilities include fuels, such as natural gas and electricity, telephone and public services, such as water and sewer.

[28] A consumer unit comprises either: (1) all members of a particular household who are related by blood, marriage, adoption, or other legal arrangements; (2) a person living alone or sharing a household with others or living as a roomer in a private home or lodging house or in permanent living quarters in a hotel or motel, but who is financially independent; or (3) two or more persons living together who use their incomes to make joint expenditure decisions. Financial independence is determined by the three major expenses categories: housing, food, and other living expenses. To be considered financially independent, at least two of the three major expense categories have to be provided entirely or in part by the respondent.

[29] See Short et al. 1999 for examples of using different units of analysis.

the housing nor the mortgage principal payment are included in expenditures; however, mortgage interest and related charges were included along with homeowners insurance and property taxes.

While the experimental poverty thresholds have been calculated over this period of time, in general, associated standard errors have been lacking.[30] While the current official poverty thresholds were originally based on estimates from survey data, they are not treated as estimates but rather as given parameters. No standard errors for poverty thresholds are calculated or employed in the current calculations of official poverty statistics even though they are udpated every year using the CPI-U, which itself has an associated standard error.

Three sets of thresholds are calculated: the current official and a set of experimental thresholds based on CE data. We describe the different thresholds and show how they change over time from our first calculation for 1990 to the most currents thresholds available, 2000.

> --The official thresholds, those currently in use by the Census Bureau, were defined during the 1960s by Mollie Orshansky and adopted by OMB in Statistical Policy Directive 14. They were based on estimates of nutritional need from a food consumption survey and data from a 1955 budget survey. These thresholds have been updated every year using the CPI-U for all items.
>
> --The thresholds that are calculated from CE data follow the recommendations of the NAS Panel -- based on three-year moving averages, updated each year. These thresholds are based on median spending of a 2-adult and 2-child family on food, clothing, shelter and utilities with a bit more for personal necessities. Also shown are the preliminary upper and lower bound of confidence intervals using those based on the estimated medians.
>
> --The NAS Panel further recommended that for a period of time the Census Bureau should report poverty statistics that use the thresholds calculated from the CE for one year, but update them for later years with the CPI-U for all items, as is currently done for the official thresholds. We show that set of thresholds over the period from 1990 to 2000. The series in **Figure 6** shows an experimental threshold for 1997, updated to 2000 and backdated to 1990 using the CPI-U for all items. Note that the chart is scaled so that differences among the lines are more easily discernable.

As shown in the figure, there are some differences in the poverty thresholds over this period of time. The chart shows the official thresholds updated each year with the overall CPI. The FCSU line represents the thresholds calculated following the basic recommendations of the NAS Panel. As can be seen there, there is more variability in this line, compared with the official thresholds. Because this set of thresholds is based

each year on estimates from survey data, we expect this to be the case. As such, preliminary confidence intervals suggest that the trend lines are not statistically significantly different from one another.[31] Nevertheless, there will be differences in estimated poverty rates using the different thresholds exist.

The CPI97 line that lies below the official threshold represents the experimental threshold calculated for 1997 estimates. This threshold is based on estimates from the 1995 to 1998 CE and was used in the first Census Bureau report (Short et al. 1999). Since that time we have followed the advice of the NAS Panel and computed poverty statistics based on the 1997 estimates but updated using the CPI, just like the official thresholds. Thus, those two trend lines are parallel.

As seen in the figure, the experimental thresholds were below the official thresholds in only two years, 1996 and 1997. It is a matter of coincidence that our original report, released in 1999, fixed the experimental threshold in 1997, one of the two years in the past decade for which the experimental threshold was below the official. This explains why the experimental poverty rates based on CPI-adjusted experimental thresholds are below the official poverty rates. This is an important note to keep in mind when examining the results below.

One important trend to note in the figure is that the CE-based thresholds increase by more than the CPI since 1997. Presumably this increase represents the improved economic conditions and consumer confidence over this time period. This increase in expenditures translates into higher poverty thresholds that would be calculated if only price changes were used. This change in expenditures can affect our poverty estimates. (Note again that these are probably not statistically significant differences.)

Figure 7 shows changes in the official poverty rates and two experimental poverty measures. The measure referred to as MSI is named for the way medical out-of-pocket expenses (MOOP) are treated. In this

[30] One exception is that such variances were produced by Johnson et al., 1997.

[31] We find that the standard errors of the median FCSU expenditures increase for threshold years 1990 through 1995 and then decrease thereafter. Preliminary analysis suggests that this pattern relates to the underlying raw expenditure data rather than to the replicate weighting methodology used for the production of CE estimates. Thanks for Swanson and Ferguson (2002) for their assistance examining the standard errors of the overall data.

measure, MOOP is subtracted from income, consistent with the NAS recommendations[32]. The experimental measures include a value for food stamps, school lunches and housing subsidies in family income and subtract taxes, work expenses, and MOOP. Both adjust thresholds for geographic differences in housing costs. The only difference between MSI and MSICPI are the updating mechanism for the poverty thresholds. The first uses the FCSU thresholds based on CE data and the second uses only the 1997 FCSU threshold updated with the CPI.

The chart shows that the MSI measure is slightly higher in both years, 1999 and 2000, while the MSICPI measure is the lowest. Note that between 1999 and 2000 the official measures suggests that the incidence of poverty was declining over the period. In fact, the official 2000 estimates are at historically low levels (though not significantly different from the 1973 level of 11.1%). On the other hand we see that poverty rates under the MSI measure appear to increase. While most of the increases are not significant in the statistical sense, nonetheless, under the MSI experimental measure we would have concluded there was no statistically significant change for poverty rates between 1999 and 2000 rather than a decline as suggested by the official measure. Note that the experimental measures that use thresholds updated from 1997 with only the CPI does also does not show a statistically significant change, but declines nominally between 1999 and 2000.

D. Conclusions

This paper has reviewed the proposals for revising the official poverty thresholds recommended by the NAS Panel. Applying most of the recommendations, poverty thresholds have been presented for a the period of time from 1990 to 2000 in order to examine some of the assumptions made by the Panel in their recommendations and to observe behavior of these estimates over time. Overall, it would appear that the thresholds behave with a reasonable amount of stability and offer a viable alternative to the current official thresholds.

[32] See Short, 2001, for details about the experimental measures .

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Table 1: Distribution of family types in CE: 1998 Quarter 2 to 2001 Quarter 1

	Numbers	Percent
A	27,386	32.1
2A	21,702	25.4
3A+	5,733	6.7
A+K	2,997	3.5
A+2K	3,220	3.8
2A+K	6,706	7.9
2A+2K	7,668	9.0
2A+3K	4,435	5.2
3A++K+	5,494	6.4
Total	85,341	100.0

where A=Adult and K=Children

Table 2: Expenditures for basic group of commodities by various family types: 2000

Average dollar amounts over the 30th and 35th percentiles ranked by FCSUM

	Reference family (2A + 2K)	Singles (A)	Lone parents	Elderly
Total	$4,059	$1,915	$2,557	$2,231
Food	1,391	596	895	688
Shelter	1,368	652	880	523
Utilities	660	353	464	353
Apparel	306	93	203	75
Medical	333	253	115	592
Percent of FCSUM spending				
Total	100	100	100	100
Food	34	31	35	31
Shelter	34	34	34	23
Utilities	16	18	18	16
Apparel	8	5	8	3
Medical	8	13	4	27

Table 3: Median FCSU by various family types: 1990 - 2000

	Percent change	1990	1991	1992	1993	1994	1995	1996	1997
A	32%	6,877	7,062	7,211	7,330	7,769	7,769	8,000	8,511
2A	30%	9,812	10,272	10,342	10,647	11,180	11,180	11,576	12,192
3A+	29%	12,463	12,635	12,913	13,235	14,068	14,068	14,487	15,142
A+K	36%	8,647	8,954	9,219	9,616	10,233	10,233	10,429	10,868
A+2K	39%	9,209	9,645	9,919	10,198	10,674	10,674	11,242	11,835
2A+K	32%	12,429	13,115	13,266	13,506	13,813	13,813	14,531	15,559
2A+2K	**33%**	**13,852**	**14,388**	**14,768**	**15,308**	**16,039**	**16,039**	**16,242**	**17,076**
2A+3K	33%	13,924	14,658	15,090	15,725	16,470	16,470	16,802	17,511
3A++K+	24%	14,832	15,313	15,588	15,695	16,160	16,160	16,499	17,097

where A=Adult and K=children

Table 4: Proportion of FCSUM thresholds by reference family: 1990 and 2000

Average over the 30th and 35th percentiles ranked by FCSUM

Reference family (2A + 2K)

	1990	2000	% change
Food	0.31	0.29	-0.06
Clothing	0.08	0.06	-0.25
Shelter	0.24	0.28	0.17
Utilities	0.14	0.14	0.00
Medical	0.08	0.07	-0.13

Singles (A)

	1990	2000	% change
Food	0.28	0.26	-0.06
Clothing	0.05	0.04	-0.24
Shelter	0.27	0.29	0.05
Utilities	0.15	0.16	0.04
Medical	0.10	0.11	0.12

Table 5: FCSU Expenditures, PCE, Income, and Prices: 1990 to 2000

	FCSU	*Preliminary* Upper C.I.	*Preliminary* Lower C.I.	Per capita PCE	Median Income*	CPI-adjusted FCSU
1990	$13,852	14,265	13,439	$15,327	$41,451	$13,852
1991	14,388	14,841	13,935	15,676	43,056	14,435
1992	14,768	15,349	14,187	16,401	44,251	14,869
1993	15,308	15,913	14,702	17,131	45,161	15,315
1994	15,683	16,339	15,027	17,918	47,012	15,707
1995	16,039	16,736	15,342	18,655	49,687	16,152
1996	16,242	16,866	15,618	19,435	51,518	16,629
1997	16,526	16,991	16,061	20,272	53,350	17,010
1998	17,076	17,581	16,571	21,221	56,061	17,275
1999	17,613	18,061	17,164	22,391	59,981	17,657
2000	18,489	18,942	18,037	23,818	62,228	18,250
% change	33.48			55.40	50.12	31.75

* Median before -tax income for a four-person family

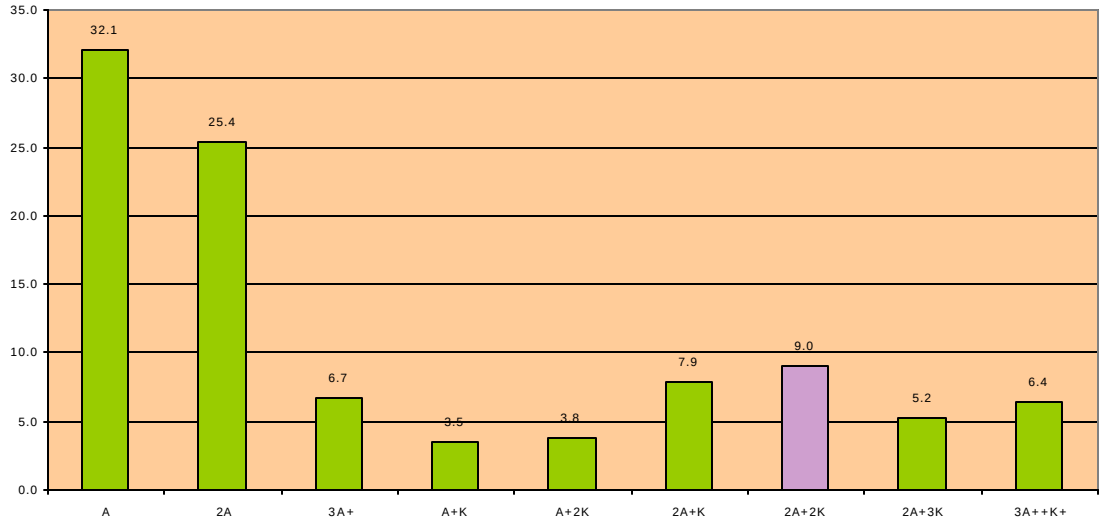
Table 6: Poverty Thresholds for Reference Family: 1990 to 2000

	Official	FCSU	*Preliminary* Upper C.I.	Lower C.I.	CPI97
1990	$13,254	$13,398	$13,798	$12,999	$13,017
1991	13,812	13,917	14,355	13,478	13,565
1992	14,228	14,284	14,846	13,723	13,973
1993	14,654	14,806	15,392	14,221	14,391
1994	15,029	15,169	15,804	14,535	14,760
1995	15,455	15,514	16,188	14,840	15,178
1996	15,911	15,710	16,313	15,107	15,626
1997	16,276	15,985	16,435	15,535	15,985
1998	16,530	16,517	17,005	16,029	16,234
1999	16,895	17,036	17,470	16,602	16,592
2000	17,463	17,884	18,321	17,446	17,150

Table 7: Poverty rates using different measures: 1999 and 2000

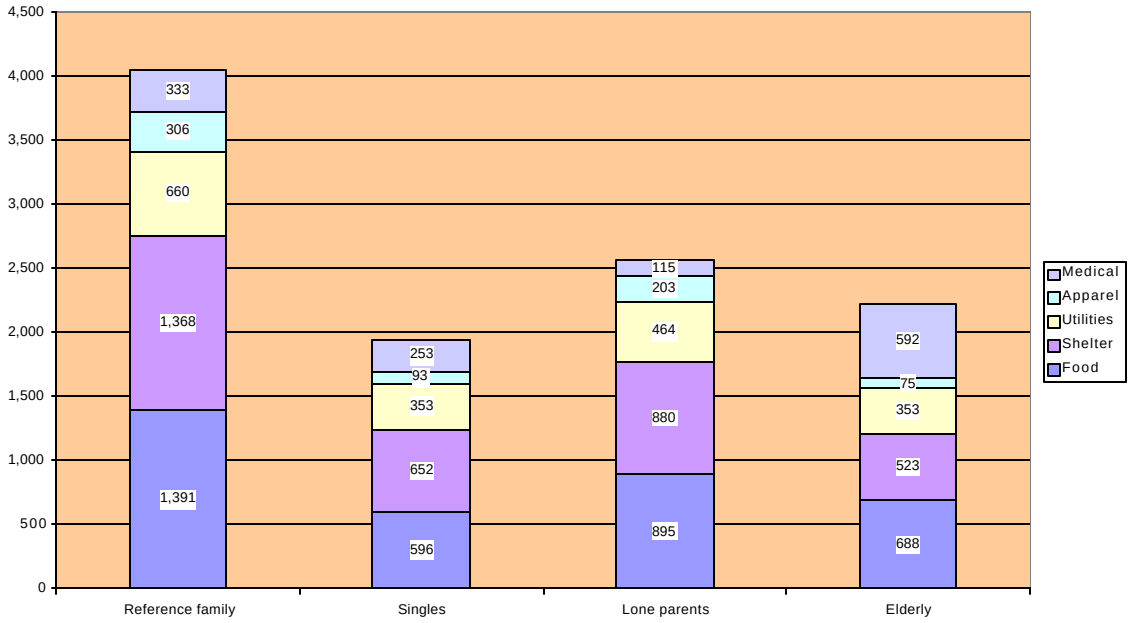
	Official		MSI		MSICPI	
	1999	2000	1999	2000	1999	2000
All persons	11.8	11.3	12.0	12.2	11.3	11.1
Age						
Children	16.9	16.1	14.1	14.6	13.2	13.0
Nonelderly adults	10.0	9.4	10.5	10.4	10.0	9.6
Elderly	9.7	10.2	15.1	16.6	14.4	15.1
Health Insurance						
Some private	4.9	4.8	5.8	6.2	5.5	5.6
Only public insurance	41.2	40.4	35.9	36.8	33.9	33.5
No health insurance	31.0	29.2	32.7	33.7	31.3	31.7
Race						
White	9.8	9.4	10.5	10.7	9.9	9.8
Black	23.6	22.0	20.3	20.6	19.3	18.6
Other	14.4	13.8	15.0	15.0	14.2	13.5
Hispanic origin	22.8	21.2	24.3	24.2	22.7	22.0
Family workers						
No workers	32.7	33.2	33.8	35.4	32.4	33.4
One or more workers	8.6	8.0	8.7	8.7	8.2	7.8
Persons in family of type:						
Married couple	5.8	5.6	6.4	6.9	5.9	6.1
Male householder	14.9	14.8	16.3	17.3	15.6	16.3
Female householder	27.5	25.7	26.0	25.1	24.8	23.0
Geographic regions:						
Northeast	10.9	10.3	13.4	12.9	12.7	11.6
Midwest	9.8	9.5	8.6	9.0	8.0	8.4
South	13.1	12.5	12.0	12.2	11.3	11.1
West	12.6	11.9	14.4	14.9	13.7	13.5
Metropolitan area:						
Central city	16.4	16.1	16.7	17.6	15.8	16.0
Not central city	8.3	7.8	9.7	9.8	9.1	8.9
Nonmetropolitan area	14.3	13.4	11.0	10.8	10.5	10.0

Figure 1: Distribution of Family Types as Estimated for Threshold Year 2000



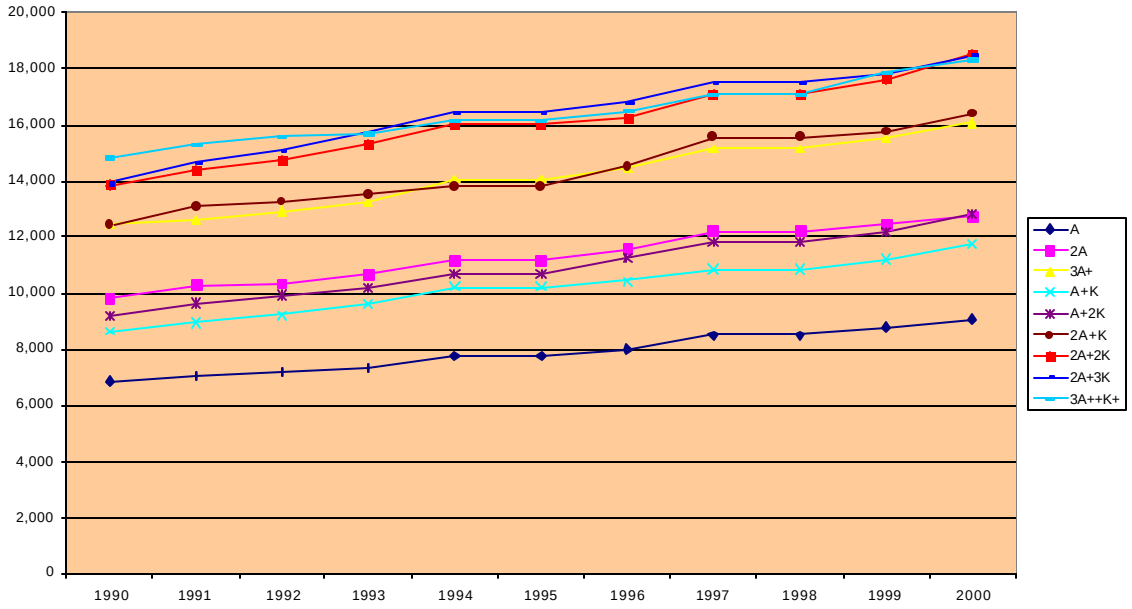
Notes: A = Adults, K=Children
Source: CE 1998 quarter 2 to 2001 quarter 1.

Figure 2: FCSUM Quarterly Expenditures by Selected Family Types in 2000 Dollars



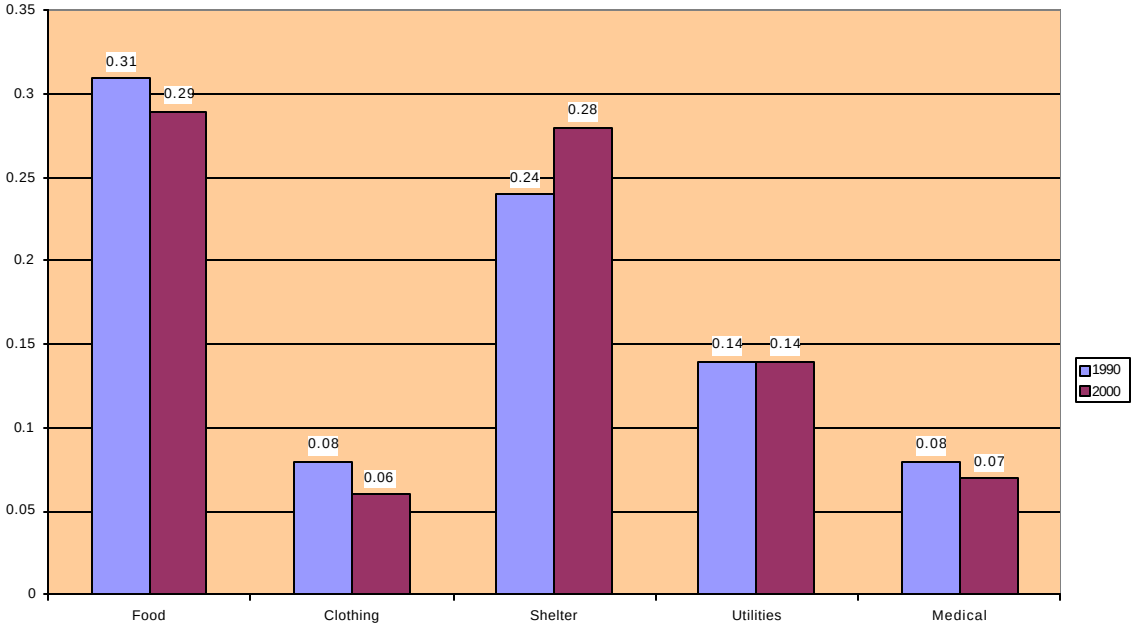
Source: CE 1998 quarter 2 to 2001 quarter 1

Figure 3: Median FCSU by Family Type in Current Dollars



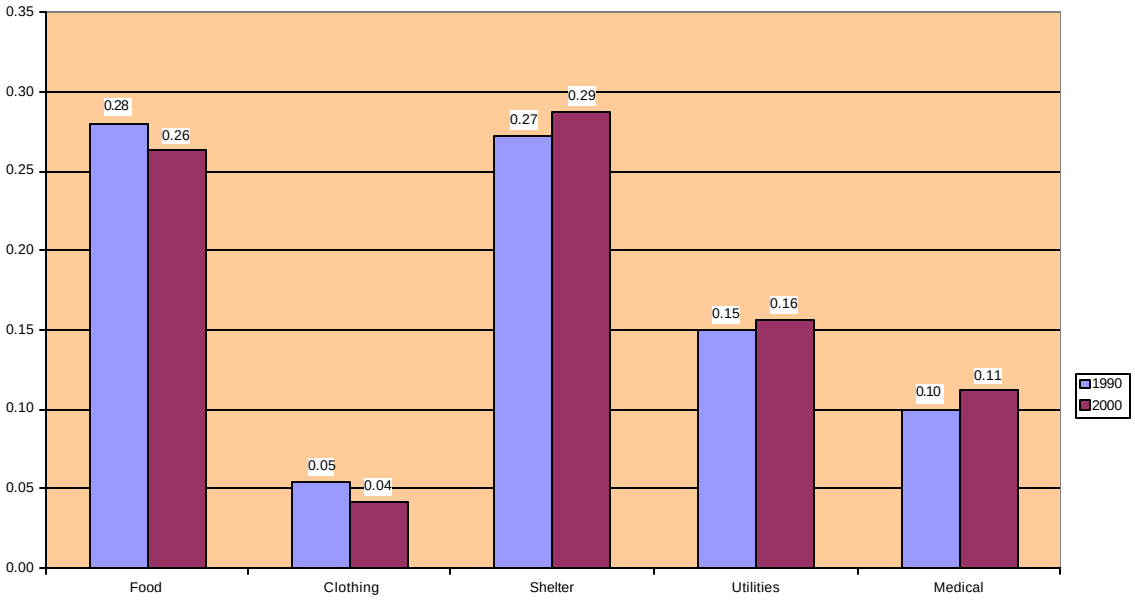
Source: CE 1988 quarter 2 to 2001 quarter 1

Figure 4a: Proportion of FCSUM Thresholds by the Reference Family 1990 and 2000



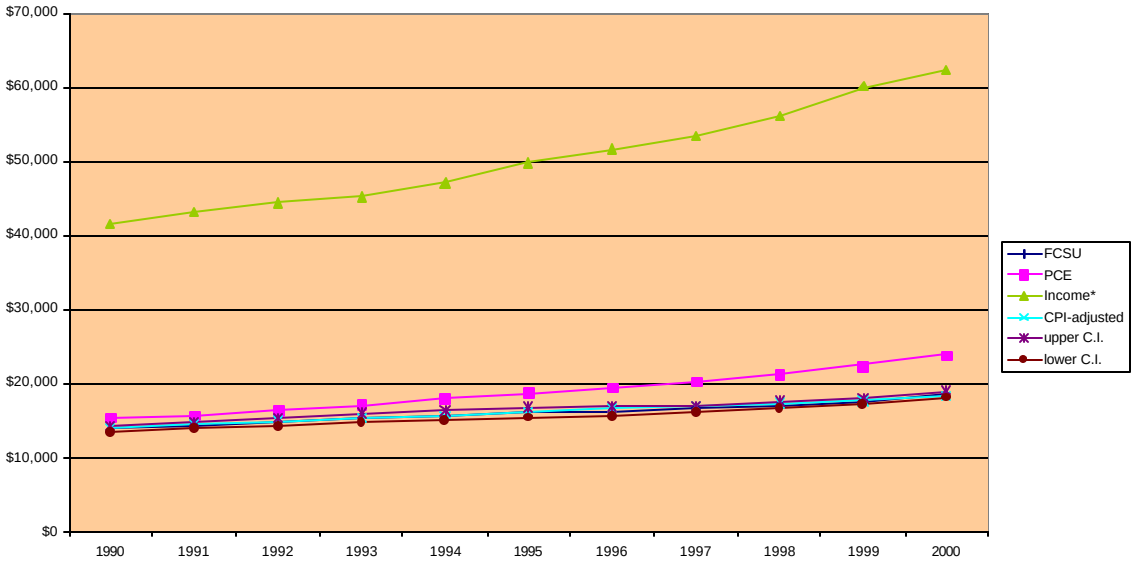
Source: CE 1988 quarter 2 to 1991 quarter 1 and 1998 quarter 2 to 2001 quarter1

Figure 4b: Proportion of FCSUM Thresholds by Singles
1990 to 2000



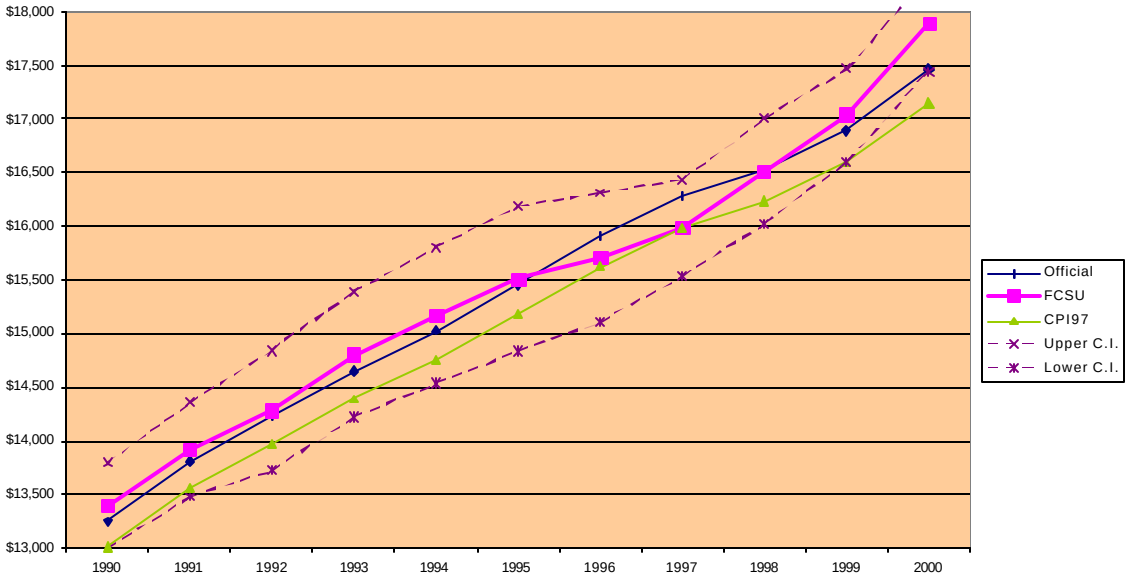
Source: CE 1988 quarter 2 to 1991 quarter 1 and 1998 quarter 2 to 2001 quarter1

Figure 5: Median FCSU, Per Capita PCE, Median Income, CPI-adjusted FCSU:
1990- 2000



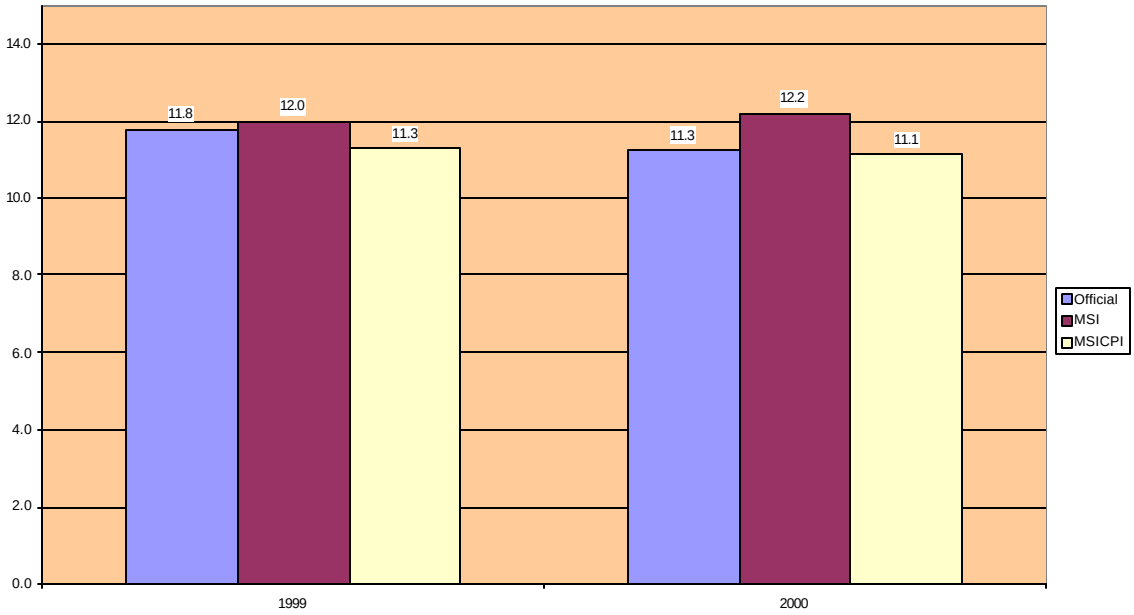
* Four-person median family income.
Sources: CE Interview data, http://www.census.gov, http://www.bea.doc.gov, http://www.bls.gov.

Figure 6: Thresholds 1990-2000 in Current Dollars



Source: CE Interview data 1988 quarter2 to 2001 quarter 1

Figure 7: Poverty Rates for 1999 and 2000



Source: March 2000 and March 2001 CPS