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### Is the United States CPI Biased Across Income and Age Groups?

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#### Abstract

The recent Boskin Commission Report (1996) underscores a significant upward bias in CPI measurement in the United States. This may result in excessive cost-of-living adjustment (COLA) of some entitlements in the federal budget because COLA is indexed to CPI. This paper presents some evidence that overall CPI may be biased against lower income elderly households, the primary beneficiaries of COLA. Although a downward adjustment in CPI resulting in an across-the-board cut in COLA of entitlements may yield significant budgetary savings, it may result in a deterioration in income distribution against lower income elderly households.

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|             | Contents   | Page |
|-------------|--|------|
| Summary     |  | 4    |
| I.          | Introduction   | 5    |
| II.         | Estimation Methodology   | 7    |
|             | A. Description of Data and Calculation of the Income and Age Cohorts' Expenditure Weights  | 7    |
|             | B. Estimation of CPI-W Indexes, 1986-95, 1986/87-1994/95   | 8    |
|             | 1. The overall CPI-W indexes for income and age samples  | 8    |
|             | 2. The CPI-W indexes excluding a major expenditure category  | 10   |
| III.        | Results and Significance Tests   | 12   |
|             | A. Cumulative Overall CPI-W Inflation  | 12   |
|             | B. Cumulative CPI-W Inflation for Income and Age Cohorts   | 12   |
|             | C. The Relative Significance of Major Expenditure Components in Income and Age Bias  | 12   |
|             | D. Income Bias Among Age Cohorts, 1986/87-1994/95  | 15   |
| IV.         | Conclusion   | 19   |
| Text Tables |  |      |
| 1.          | Weights of Major CPI-W Components, 1986-87, 1986/87  | 9    |
| 2.          | Actual and Estimated Overall CPI-W Inflation (Cumulative 1986-87, 1986/87-1994/95)   | 11   |
| 3.          | CPI-W Inflation Bias Among Income and Age Cohorts, (Cumulative, 1986-87, 1986/87-1994/95)  | 13   |
| 4.          | Relative Significance of Major Expenditure Components in Income and Age Bias, 1986-87, 1986/87-1994/95                                 | 16   |
| 5.          | Income Bias Among Age Cohorts, (Cumulative CPI-W Inflation, 1986/87-1994/95)   | 18   |
| 6.          | Significance Tests for Income Bias Among Age Cohorts and Age Bias Among Income Cohorts (Cumulative CPI-W Inflation, 1986/87-1994/95)   | 18   |
| Chart 1.    | Deviation of Estimated Cohort CPI-W Inflation From Estimated CPI-W Inflation for All Households (Cumulative, 1986-87, 1986/87-1994/95) | 14   |

|   |    |
|---|----|
| Appendix I .....  | 20 |
| Box 1. Composition of CES Data on Expenditures of Income and Age Cohorts, 1986-95 .....   | 22 |
| Box 2. Composition of CES Data on Expenditures by Income Cohorts in Different Age Groups, 1986/87-1994/95 .....   | 22 |
| Table 7. CES and This Study's Classification of Household Expenditures .....  | 23 |
| Appendix II - Tables .....  | 24 |
| 8. Expenditure Weights of Income Cohorts, 1986, 1986/87 .....   | 24 |
| 9. Expenditure Weights of Age Cohorts, 1986, 1986/87 .....  | 25 |
| 10. Expenditure Weights of Income Cohorts in Different Age Groups, 1986/87 .....  | 26 |
| 11. Estimated Overall CPI-W Inflation Excluding a Given Category of Expenditure and Actual CPI-W Inflation (Cumulative, 1986-87, 1986/87-1994/95) .....   | 29 |
| 12. Deviation of Estimated Income Cohort CPI-W Inflation from Estimated CPI-W Inflation for All Households Excluding Selected Expenditure Categories (Cumulative, 1986-87, 1986/87-1994/95) ..... | 30 |
| 13. Deviation of Estimated Age Cohort CPI-W Inflation from Estimated CPI-W Inflation for All Households Excluding Selected Expenditure Categories (Cumulative, 1986-87, 1986/87-1994/95) .....    | 31 |
| 14. Hypothetical Example on Evaluating the Relative Significance of an Expenditure Component .....  | 32 |
| Bibliography .....  | 33 |

## Summary

The Boskin Commission Report (1996) underscores a significant upward bias in CPI measurement in the U.S. The report does not focus on the possibly significant biases in CPI stemming from income distribution and age. However, a large portion of the cost-of-living adjusted (COLA) entitlements in the federal budget are paid to the lower income groups and the elderly.

This paper updates and extends the previous literature on income and age bias in CPI measurement by examining data for recent years and also by focusing on cross-correlations between income and age. It focuses on CPI-W (Consumer Price Index for Urban Wage Earners and Clerical Workers), the basis for budgetary COLA. The estimation periods are 1986-95 and 1986/87-1994/95. Using data on CPI-W and household expenditures in *Consumer Expenditure Surveys*, the following indexes are constructed: overall CPI-W; CPI-Ws for *all households* in the samples for household expenditures by income bracket and age group; and CPI-Ws for *household cohorts* in different income and age groups. The paper compares the cumulative CPI-W inflation for all households in the income sample to the cumulative CPI-W inflation for household cohorts in different income groups, and, the cumulative CPI-W inflation for all households in the age sample to the cumulative CPI-W inflation for the household cohorts in different age groups. The results indicate that CPI-W inflation for lower income and higher age cohorts may be significantly higher than inflation for higher income and lower age cohorts. Expenditure data on cross-correlations between income and age indicate that, while income bias is significant, age bias is not significant.

The paper concludes with the caveat that, although an across-the-board downward adjustment in CPI may yield significant budgetary savings, it may also result in a relative deterioration in income distribution against lower income elderly households, the primary beneficiaries of COLA.

## I. INTRODUCTION

The recent Boskin Commission Report (1996) proposes a number of important adjustments to the estimation of the Consumer Price Index (CPI) in the United States. The general finding of the Report is that, as currently calculated by the Bureau of Labor Statistics (BLS) and used by the Congress for budgetary cost-of-living adjustment (COLA) purposes, the CPI overstates actual price increases. Budgetary arithmetic on the basis of the large magnitudes involved in the Federal budget would suggest that, if the CPI were adjusted downward along the lines of the refinements recommended by the Report, budgetary savings over time would be substantial. *Ceteris paribus*, such a technical adjustment in the CPI would greatly facilitate achieving a balanced budget without the politically difficult discretionary expenditure cuts or tax increases.<sup>2</sup>

The Report's main focus is on the biases stemming from the statistical methods (sampling bias) and shortfalls in data compilation (for example, not compiling price data from discounters) used in CPI measurement, delayed accounting for the substitution effect (long lags in updating expenditure weights in the face of relative price changes), not reflecting improvements in product quality (notably, computers and cars), and long lags in including new products in the sample of household expenditures (for example, cellular telephones). The Report's focus is not on the possibly significant biases in the CPI stemming from income distribution and age.<sup>3</sup> However, these issues are important since a large portion of cost-of-living adjusted entitlements in the Federal budget is paid to the lower income groups and the elderly.<sup>4</sup>

Issues involving measurement and bias in the CPI have also been discussed by such researchers as the Congressional Budget Office (1994), Diewert (1996), Moulton (1996), and Shapiro and Wilcox (1996), to name a few recent studies.

The hypothesis that price indices for specific demographic groups may differ from the mean is not a new one. For example, early researchers such as Konus (1939), Arrow (1958), Prais (1959) and Nicholson (1975) discussed issues involving a need for separate price indices for certain households or demographic groups whose consumption patterns differ from the averages utilized in order to calculate the expenditure weights for the aggregate price statistics.

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<sup>2</sup> An excellent recent commentary on the surfacing politics of this issue is by Pollak (1998).

<sup>3</sup> The Report questions whether a separate CPI should be calculated for the elderly and notes that the evidence for a separate CPI for the elderly is weak (p. 71).

<sup>4</sup> For example, according to a Congressional Budget Office (CBO) study (1994), about 52 percent of the families receiving entitlement benefits had annual incomes less than \$20,000 in 1990 and the benefits received by such families accounted for 45 percent of all benefits paid; the elderly (more than 65 years old) accounted for 43 percent of all recipients and 58 percent of all benefits paid (Table 10, p. 28 of that study).

Some theoretical discussions of individual and group cost-of-living indexes are by Jorgenson and Slesnick (1983) and Pollak (1989). Empirically, Michael (1979) analyzed the variation across households in price indexes and found that, although some significant differences between specific groups existed, the dispersion within those specific groups was large. Thus, Michael concluded that, if group-specific price indexes were utilized, this would not eliminate the majority of the distributional effects of inflation and, in the long run, no specific group would suffer disproportionately from inflation. Hagemann (1982) updated and extended the work of Michael, concentrating on possible sources of deviation of price indexes of retirees (such as energy, medical care and hospitalization) versus the typical CPI-W household, and suggested that the focus should be on the price behavior of particular commodities which most severely impact retirees. Boskin and Hurd (1985) focussed on the difference in inflation between the elderly and non-elderly, concluding that there was little difference between groups after adjusting for housing expenditures.<sup>5</sup> Kokoski (1987) found some evidence that cost-of-living differences might be correlated with demographic attributes, especially family composition.

More recently, Amble and Stewart (1994) constructed experimental price indexes for the elderly and found that the price index for older Americans rose somewhat faster than CPI-U and CPI-W. On the other hand, the experimental price indexes constructed by Garner, Johnson and Kokoski (1996) showed that poor and the general population faced similar price trends.

This paper updates and extends the previous literature by examining data for recent years and also by focussing on cross-correlations between income and age. Our focus is the CPI-W, which is the basis for budgetary COLA.<sup>6</sup> Utilizing publicly available BLS data on the CPI-W and the data on household expenditures in the *Consumer Expenditure Surveys* (henceforth, CES), we construct the following indexes: the overall CPI-W; the CPI-Ws for *all households* in the samples for household expenditures by income and age groups<sup>7</sup>; and, the CPI-Ws for household cohorts in different income and age groups. All the indexes are estimated for the periods 1986-95 and 1986/87-1994/95, with 1986 and 1986/87 taken as the base periods. We compare the cumulative CPI-W inflation for all households in the income sample to the cumulative CPI-W inflation for the household cohorts in different income groups, and, the cumulative CPI-W

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<sup>5</sup>The Boskin and Hurd study extended a study by the United States General Accounting Office (1982), which focussed on the need for adjustment in the home ownership component of the CPI.

<sup>6</sup> The results in the case of the other major CPI index, CPI-U (Consumer Price Index for All Urban Consumers), are broadly the same as the results for CPI-W; the results for CPI-U are available from the authors on request.

<sup>7</sup> That is, all households in the sample of household expenditures differentiated by income group and all households in the sample of household expenditures differentiated by age group. So, *all households* means the average of all income or age groups in the samples (Boxes 1, 2).

inflation for all households in the age sample to the cumulative CPI-W inflation for the household cohorts in different age groups. The results indicate that CPI-W biases may be present across different income and age cohorts and the increase in the cost-of-living of lower income and higher age cohorts may be significantly higher. These results are found to be robust when they are tested by estimating the relevant CPI-Ws excluding selected main expenditure categories that make up total expenditures reported in the CES. Further tests using expenditure data on cross-correlations between income and age indicate that while income bias in CPI-W is significant, age bias is not significant.

In view of these results, a correction of an upward bias in CPI measurement may not be neutral across income and age groups that benefit from COLA. We conclude with the caveat that an across-the-board downward adjustment in CPI can potentially affect more adversely the lower income elderly households (income less than \$20,000 per year, ages 65 and older), the primary beneficiaries of COLA. Although a downward adjustment in CPI resulting in an across-the-board cut in COLA of entitlements may yield significant budgetary savings, it may also result in a deterioration in income distribution against lower income elderly households.<sup>8</sup>

The paper is organized as follows: in Section II, the estimation methodology is briefly explained and the findings are summarized; in Section III, the results are interpreted and some significance tests are performed; Section IV concludes; the nature and components of CES data are compared to the CPI market basket data and the household expenditure classification used in this study is explained in Appendix I; some additional results are presented in the Appendix II.

## II. ESTIMATION METHODOLOGY

### A. Description of Data and Calculation of Income and Age Cohorts' Expenditure Weights

The yearly data for the periods 1986-95 and 1986/87-1994/95 on the CPI-W indexes and household expenditures come from three bases: *CPI Statistics*; CES; and *Relative Importance of Components of the Consumer Price Indexes* (henceforth, *Relative Importances*) on which the *official CPI market basket item classification* is based. For all data, the source is the U.S. Department of Labor, BLS.

The composition of the CES expenditure data in 1986-95 on income and age groups is shown in Appendix I, Box 1. Additionally, the cross-tabulated CES data are available on the

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<sup>8</sup> Since CPI-U is used for adjusting income tax brackets for inflation, an important complementary issue is the potentially uneven impact of a downward adjustment of CPI-U on the tax burden of households in different income and age groups due to income and age biases. This issue is outside the scope of the present paper. However, as noted earlier, our results indicate similar income and age biases for CPI-U also.

expenditures of a given age group differentiated by income level for the period 1986/87-1994/95; the composition of these data is shown in Appendix I, Box 2.

The period 1986 or 1986/87 is taken as the base period for the construction of the price indexes (1986 = 100; 1986/87 = 100). The expenditure weights of each income and age group are derived from the CES data explained in Boxes 1,2. The expenditure weights are based on the seven major components of the official CPI market basket item classification for which separate prices series are reported. Those components are: (a) food and beverages (including alcoholic beverages); (b) housing; (c) apparel and upkeep; (d) transportation; (e) medical care; (f) entertainment; and, (g) other goods and services.

The weights we derive for *all households* in the income and age samples shown in Boxes 1, 2 differ from the weights reported in the official CPI market basket for 1986 (Appendix I). The official CPI-W market basket weights and the expenditure weights for all households in the income and age samples based on CES data and used for estimation for the purposes of this study are shown in Table 1<sup>9</sup>; Tables 8, 9 show the weights used for the income and age cohorts (Box 1).<sup>10</sup> Finally, Table 10 shows the weights based on CES data used for estimating the CPI-W for income groups in each age group (Box 2).<sup>11</sup>

## **B. Estimation of CPI-W Indexes, 1986-95, 1986/87-1994/95**

### **1. The overall CPI-W indexes for income and age samples**

The estimates for overall CPI-W for 1986-95 are based on the BLS data on the CPI-W series for the major expenditure categories (a)-(g). First, the reported price series for (a)-(g) are rebased at 1986 = 100. The expenditure weights in 1986 for (a)-(g) are those reported in

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<sup>9</sup> The official CPI-W market basket weights for 1986 reported in the *Relative Importances* have been amended in 1987 for certain classification changes adopted in 1987 (*Relative Importances*, 1987). In this study, the 1986 weights we use for estimating CPI are the *amended* 1986 weights.

<sup>10</sup> The differences between the weights for *all households* in the income sample and the age sample are mainly due to the differences between the sample sizes (Appendix I).

<sup>11</sup> The samples for all households in a given age group for these data are smaller than the samples for all consumers units in all income and age groups (Appendix I).



Table 1. Weights of Major CPI-W Components, 1986, 1986/87

|  | 1986                                      | Average<br>1986/87 |
|--|---|--------------------|
|  | (In percent)                              |                    |
|  | <u>CPI-W market basket weights 1/</u>     |                    |
| Overall CPI-W (SA0)                    | 100.0                                     | 100.0              |
| (a) Food and alcoholic beverages (SA1) | 19.7                                      | 19.6               |
| (b) Housing (SA2)                      | 40.3                                      | 40.1               |
| (c) Apparel and upkeep (SA3)           | 6.3                                       | 6.3                |
| (d) Transportation (SA4)               | 19.0                                      | 19.2               |
| (e) Medical care (SA5)                 | 4.9                                       | 4.9                |
| (f) Entertainment (SA6)                | 4.1                                       | 4.1                |
| (g) Other goods and services (SA7)     | 5.7                                       | 5.8                |
|  | <u>All households in income sample 2/</u> |                    |
| Overall CPI-W                          | 100.0                                     | 100.0              |
| (a) Food and alcoholic beverages       | 17.9                                      | 18.3               |
| (b) Housing                            | 36.3                                      | 36.4               |
| (c) Apparel and upkeep                 | 6.5                                       | 6.6                |
| (d) Transportation                     | 22.9                                      | 22.1               |
| (e) Medical care                       | 5.4                                       | 5.3                |
| (f) Entertainment                      | 4.4                                       | 4.5                |
| (g) Other goods and services           | 6.6                                       | 6.8                |
|  | <u>All households in age sample 2/</u>    |                    |
| Overall CPI-W                          | 100.0                                     | 100.0              |
| (a) Food and alcoholic beverages       | 17.7                                      | 18.1               |
| (b) Housing                            | 36.5                                      | 36.7               |
| (c) Apparel and upkeep                 | 6.4                                       | 6.6                |
| (d) Transportation                     | 23.1                                      | 22.2               |
| (e) Medical care                       | 5.4                                       | 5.3                |
| (f) Entertainment                      | 4.4                                       | 4.4                |
| (g) Other goods and services           | 6.5                                       | 6.7                |

Sources: *Relative Importances* (1987), CES, authors' adjustments to CES data.

1/ Weights in *Relative Importances* (1987); the codes in parentheses are the BLS codes for the CPI-W series (CWUR0000\_\_ \_\_).

2/ Adjusted CES weights (Box 1; Table 7); 1986/87 weights are the simple averages of the 1986 and 1987 weights.

Table 1, so that the estimated  $CPI_{1986} = 100$ . For 1987-95, the weight of each CPI component in (a)-(g) is adjusted as in

$$w_{i,t} = \left( \frac{P_{i,t}}{P_{i,t-1}} \right) * w_{i,t-1} ; i = 1, 2, \dots, 7 , \quad (1)$$

where  $w_{i,t}$  is the weight and  $P_{i,t}$  is the price index corresponding to each particular component at time  $t$ . Then, the estimated CPIs for 1987-95 are

$$CPI_t = \sum_{i=1}^7 w_{i,t} , \quad (2)$$

where  $CPI_t$  is the estimated CPI in a given year in 1987-95. The estimate in (2) corresponds to the BLS methodology for estimating the CPI (Laspeyres index).<sup>12</sup> The same estimation method is used for the period 1986/87-1994/95 by utilizing the 1986/87 average weights of CPI components (Table 1). Price series for 1986/87-1994/95 are derived by averaging the prices in the relevant pairs of years and choosing 1986/87 as the “base year”. The results for the actual and estimated overall cumulative CPI-W inflation are summarized in Table 2.

## 2. The CPI-W indexes excluding a major expenditure category

To test the relative significance of a given major expenditure category among (a)-(g), we estimate CPIs excluding a given expenditure category. For this purpose, in the base year 1986 (or 1986/87), the weight of an included expenditure category is adjusted as in

$$\hat{w}_{i,1986} = \frac{w_{i,1986}}{(100 - w_{j,1986})} ; i \neq j ; i = 1, 2, \dots, 6 \quad (3)$$

where “w cap” is the adjusted weight,  $i$  refers to the included expenditure categories and  $j$  refers to the excluded expenditure category. Therefore, excluding an expenditure category in 1986,

$$CPI_{1986} = \sum_{i=1}^6 \hat{w}_{i,1986} = 100 \quad (4)$$

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<sup>12</sup> BLS *Handbook of Methods* (1997), p. 173; for a more detailed explanation of this correspondence, see Appendix I.

Table 2. Actual and Estimated Overall CPI-W Inflation  
(Cumulative, 1986-95, 1986/87-1994/95)

|   | 1986-95 | 1986/87-<br>1994/95 |
|---|---------|---------------------|
| (In percent)                                    |         |                     |
| 1. Estimated CPI 1/                             | 38.0    | 33.7                |
| 2. Actual CPI                                   | 37.9    | 33.6                |
| Error (=1-2)                                    | 0.1     | 0.1                 |
| <u>Estimated CPI-W for all households in 2/</u> |         |                     |
| 3. Income sample                                | 38.7    | 34.2                |
| Error (=3-1)                                    | 0.7     | 0.5                 |
| 4. Age sample                                   | 38.7    | 34.2                |
| Error (=4-1)                                    | 0.6     | 0.5                 |

Sources: BLS and authors' estimates.

1/ Estimated on the basis of official CPI-W market basket weights (Table 1).

2/ Estimated on the basis of the adjusted CES weights (Table 1).

Then, following (1), the expenditure weights for the included categories in 1987-95 (or 1987/88-1994/95) can be calculated as

$$\hat{w}_{i, 1986} = \frac{w_{i, 1986}}{(100 - w_{j, 1986})} ; i \neq j ; i = 1, 2, \dots, 6 \quad (5)$$

and, following (2), the CPI excluding an expenditure category during the same periods can be calculated as

$$CPI_t = \sum_{i=1}^6 \hat{w}_{i, t} \quad (6)$$

The estimates for the cumulative overall CPI-W inflation during the estimation periods excluding an expenditure category are presented in Table 11.

### III. RESULTS AND SIGNIFICANCE TESTS

#### A. Cumulative Overall CPI-W Inflation

The following observations are in order concerning our estimates in Table 2. First, the estimated overall CPI-W inflation rate corresponds to the actual CPI-W cumulative inflation rate reported by the BLS within a small margin of error.<sup>13</sup> Secondly, the differences between the actual and estimated overall CPI inflation based on the official CPI-W market basket weights and the estimated CPI inflation for *all households* in the income and age samples based on CES data are explained by classification errors in the adjusted CES classification used for estimation (Table 7), and, by errors attributable to differences in the sample sizes (Tables 8-10). Because of these estimation errors, we compare our CPI inflation estimates for the household cohorts in different income and age groups to the estimates for *all households* in the income and age samples.

#### B. Cumulative CPI-W Inflation of Income and Age Cohorts (Box 1)

Using the estimation method described in (1) and (2), we estimate overall cumulative CPI inflation (including all expenditure categories) for different income and age cohorts. Subsequently, we calculate the deviation of the estimated overall inflation for the income and age cohorts from the estimated overall inflation for all consumers in the income and age samples. These results are presented in Table 3 and plotted in Chart 1 for easy comparison.

The results indicate that both an income and an age bias were present during the estimation periods. Lower income cohorts (less than \$20,000 per year) faced higher inflation than higher income cohorts. Higher age cohorts (ages 65 and older) faced higher inflation than lower age cohorts. While the significance tests broadly confirm these observations for income cohorts, the test results for age cohorts are weaker, confirming the age bias only for the cohorts 75 years of age or older. These results suggest that the bias in CPI-W inflation might be explained more by income level than by age level. This issue will be explored more extensively in the Section III.D.

#### C. The Relative Significance of Major Expenditure Components in Income and Age Bias

Next, we attempt to determine which expenditure component among (a)-(g) was most significant in the apparent income and age bias reported in Table 3. For this purpose, we estimate cumulative inflation for all households in the income and age samples *excluding* a given expenditure component and cumulative inflation *excluding* the same expenditure component for the income and age cohorts. We then calculate the difference as shown in

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<sup>13</sup> This difference is due to the difference between the estimation of the official CPI-W index and the one used in this study (Appendix I).

Table 3. CPI-W Inflation Bias Among Income and Age Cohorts 1/ 2/  
(Cumulative, 1986-95, 1986/87-1994/95)

|  | 1986-95      | 1986/87-<br>1994/95 |
|--|--------------|---------------------|
|  | (In percent) |                     |
| <u>Income cohorts (\$1,000 per year)</u> |              |                     |
| < 5                                      | 1.0*         | 0.9*                |
| 5-9.9                                    | 0.9*         | 1.2*                |
| 10-14.9                                  | 1.1*         | 0.7*                |
| 15-19.9                                  | 0.9*         | 0.7                 |
| 20-29.9                                  | 0.0          | 0.1                 |
| 30-39.9                                  | -0.4         | -0.3                |
| 40-49.9                                  | -0.8         | -0.6                |
| 50+                                      | -0.6         | -0.6                |
| <u>Age cohorts (years)</u>               |              |                     |
| <25                                      | -0.2         | -0.3                |
| 25-34                                    | -1.2         | -1.0                |
| 35-44                                    | -0.7         | -0.6                |
| 45-54                                    | -0.2         | 0.0                 |
| 55-64                                    | 0.7          | 0.5                 |
| 65-74                                    | 2.2          | 1.8                 |
| 75+                                      | 4.4          | 3.4*                |

Source: Authors' estimates

1/ Estimated cohort CPI-W minus estimated all households CPI-W.

2/ (\*) and (\*\*) refer to t-test results at 10 and 5 percent levels of significance, respectively.

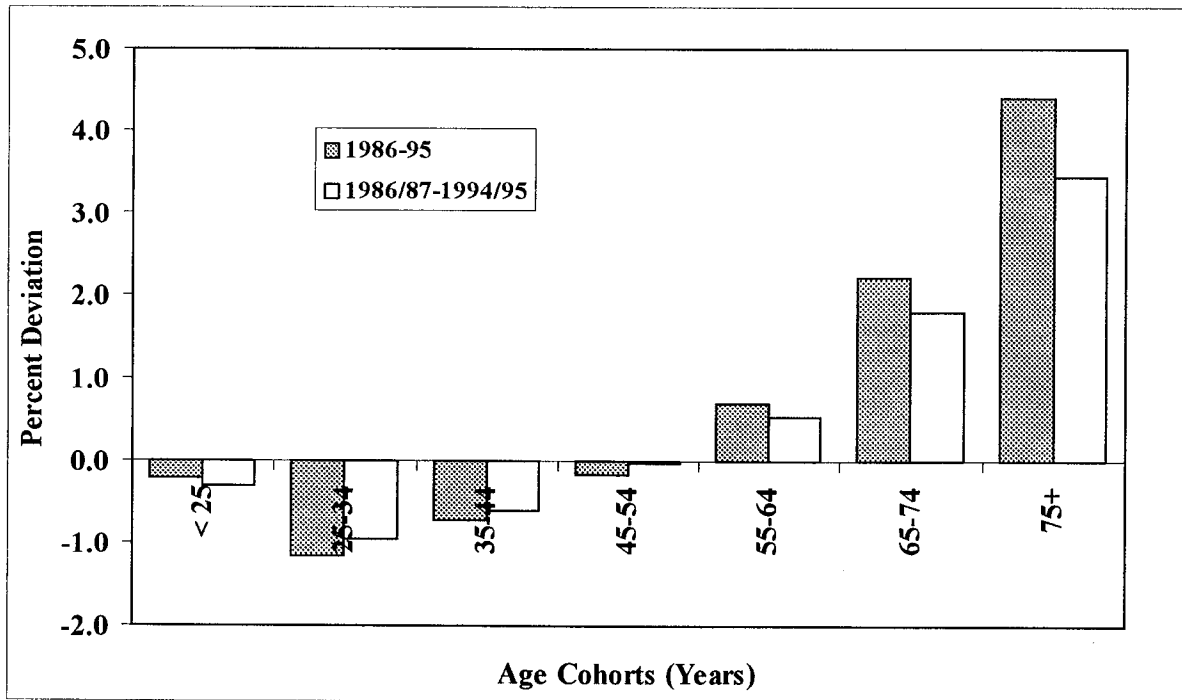
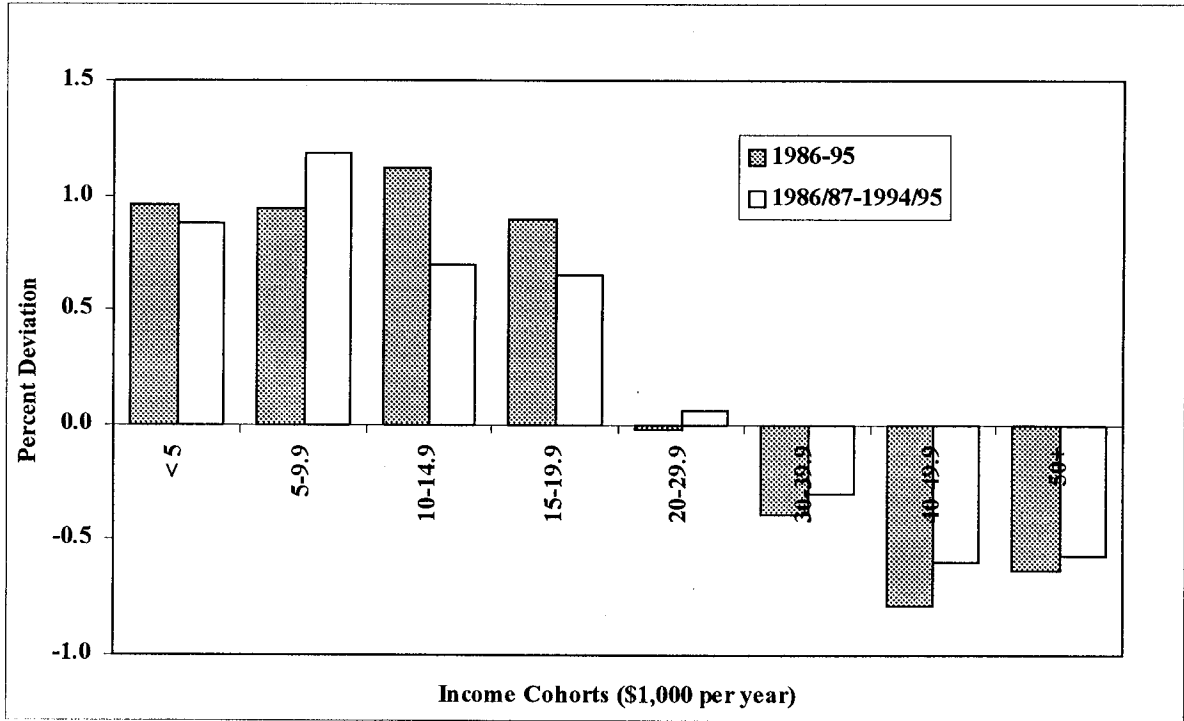
Tables 12, 13. Comparison of Tables 12, 13 to Table 3 suggests that, when a given expenditure component is excluded, income and age biases either disappear or persist, respectively, against lower income and higher age cohorts.

Then, we calculate variances excluding an expenditure component across income and age groups and compare these variance to the variances calculated *including* all expenditure components (that is, to the variances calculated for the results in Table 3). These calculations are summarized in Table 4. The interpretation is that the *smaller* the estimated variance excluding a given expenditure component relative to the variance including all expenditure component, the *more significant* is the contribution of the excluded component of expenditure to income and age bias in the overall CPI inflation *including all components of expenditure*.<sup>14</sup>

Accordingly, Table 4 indicates that, in all cases, medical care was the prominent expenditure component resulting in income and age bias. This conclusion is supported by the following observations: (i) the expenditure share of medical care of higher income cohorts was

<sup>14</sup> A hypothetical illustration is presented Table 14.

Chart 1. Deviation of Estimated Cohort CPI-W Inflation from  
Estimated CPI-W Inflation for All Households  
(Cumulative, 1986-95, 1986/87-1994/95)



lower than that of lower income cohorts (Table 8); (ii) the expenditure share of medical care of higher age cohorts was lower than that of lower age cohorts (Table 9); and, (iii) cumulative inflation for medical care during the estimation periods was the highest among the seven main expenditure components (Table 11).<sup>15</sup>

#### D. Income Bias Among Age Cohorts, 1986/87-1994/95 (Box 2)

Using the cross-tabulated data for expenditures of income cohorts in a given age group, we estimate the difference between the cumulative CPI-W inflation during 1986/87-1994/95 for different income cohorts in each age group and the CPI-W inflation for all households in each age group. The results are summarized in Table 5. When Table 5 is read horizontally, age bias is indicated in most cases; when it is read vertically income bias is indicated.

Additional tests are performed to check whether the estimates in Table 5 are income-wise and age-wise significant. These tests are based on a two factor fixed effects analysis of variance.<sup>16</sup> Let Factor A = income (8 income cohorts) and Factor B = age (7 age cohorts). In the first test, the null hypothesis is that income bias is zero; the alternative hypothesis is that income bias is present. The test statistic is

$$F^{*income} = \frac{MSA}{MSE} > F(1-\alpha; 7, 42) ; \quad (7)$$

*if  $F^{*income} > F$  reject the null hypothesis at  $\alpha$  level of significance.*

In the second test, the null hypothesis is that age bias is zero; the alternative hypothesis is that age bias is present. The test statistic is MSA is the mean-square associated with Factor A, MSB is the mean-square associated with Factor B, and MSE is the mean square error. The test results are summarized in Table 6 where it can be seen that income bias is significant and age bias is insignificant.

$$F^{*age} = \frac{MSB}{MSE} > F(1-\alpha; 6, 42) ; \quad (8)$$

*if  $F^{*age} > F(1-\alpha; 6, 42)$  reject the null hypothesis at  $\alpha$  level of significance.*

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<sup>15</sup> As for the income sample, exclusion of expenditure on *housing* results in a smaller variance (0.1) for 1986-95 but a larger variance (1.6) for 1986/87-1994/95 than the variances including all expenditure components (0.6 and 0.5 respectively) (Table 4). However, the housing weights (Table 9) and inflation in housing are comparable (Table 11) in both periods. Thus, the results appear to be contradictory in the two periods. We attribute these results to classification and sampling errors explained above.

<sup>16</sup> See Neter and Wasserman (1974).

Table 4. Relative Significance of Major Expenditure Components  
in Income and Age Bias, 1986-95, 1986/87-1994/95

|   | Variance for the deviation of<br>estimated group CPI-W inflation<br>from all households CPI-W inflation |                     |
|---|---|---------------------|
|   | 1986-95   | 1986/87-<br>1994/95 |
|   | <u>Income sample</u>  |                     |
| <u>Including all expenditure categories</u> | 0.6   | 0.5                 |
| <u>Excluding</u>                            |   |                     |
| (a) Food and alcoholic beverages            | 1.0   | 0.8                 |
| (b) Housing                                 | 0.1   | 1.6                 |
| (c) Apparel and upkeep                      | 0.5   | 0.4                 |
| (d) Transportation                          | 0.9   | 0.6                 |
| (e) Medical care                            | 0.0   | 0.0                 |
| (f) Entertainment                           | 0.7   | 0.5                 |
| (g) Other goods and services                | 0.6   | 0.5                 |
|   | <u>Age sample</u>   |                     |
| <u>Including all expenditure categories</u> | 3.8   | 2.4                 |
| <u>Excluding</u>                            |   |                     |
| (a) Food and alcoholic beverages            | 5.6   | 3.6                 |
| (b) Housing                                 | 11.2  | 7.3                 |
| (c) Apparel and upkeep                      | 3.5   | 2.3                 |
| (d) Transportation                          | 5.0   | 3.0                 |
| (e) Medical care                            | 0.2   | 0.1                 |
| (f) Entertainment                           | 4.0   | 2.5                 |
| (g) Other goods and services                | 5.3   | 3.5                 |

Source: Authors' estimates.



These results suggest that the upward bias in CPI-W inflation might be explained more by income level than by age. Indeed, it can be seen from Table 5 that the dispersion between low income elderly and high income elderly is the greatest relative to other age groups. The important implication is that an across-the-board cut in CPI-W is likely to affect the low income elderly (less than \$20,000 per year, older than 65 years of age) more severely than the high income elderly.<sup>17</sup> The same is valid for low income households less than 25 years of age.

Table 5 shows that the dispersion of CPI-W inflation over a 9 year period between the lowest and highest income elderly is in the range of 2-4 percent. Of course, to some extent, this relatively modest difference is a reflection of low inflation rates during the same period in the United States. The average yearly inflation during 1986/87-1994/95 was 3.7 percent. However, with higher inflation rates, the dispersion could potentially become larger.<sup>18</sup> Our simulations indicate that, if the yearly CPI-W inflation for every major expenditure category in (a)-(g) were higher by 5 percent resulting in an average yearly overall CPI-W inflation rate of 8.7 percent, then the dispersion of cumulative CPI-W inflation between the lowest and highest income elderly would be in the range of 3-5 percent; for an average yearly inflation of 13.7 percent, the same dispersion would rise to 4-7 percent; and, for an average yearly inflation of 18.7 percent, the dispersion would rise to 6-9 percent.<sup>19</sup>

What if the CPI-W inflation had been adjusted downward along the lines recommended by the Boskin Commission Report by 1-2 percent per year during 1986/87-1994/95? The simulations indicate that, if the yearly CPI-W inflation were adjusted downward by 1 percent, then the dispersion of cumulative CPI-W inflation between the lowest and highest income elderly would remain in the range of 2-4 percent; for a downward adjustment by 2 percent, the same dispersion would decline somewhat to the range of 2-3 percent. Similarly, in the less than 25 age group, the dispersion between the poorest and the richest cohorts would decline by only a small margin to about 2 percent. This is to say that a downward adjustment in the CPI would not result in a significant change in income bias in favor of the higher income groups and would therefore have a more adverse impact on the lower income groups than on the higher income groups.

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<sup>17</sup> One exception is that the dispersion between lowest income and highest income cohorts in the less than 25 age group (|2.6|) is somewhat larger than the dispersion between the highest income and lowest income cohorts in the less than 65-74 age group (|2.2|). Thus, poor who are in the less than 25 years of age group would also be affected more severely by an across-the-board cut in CPI-W.

<sup>18</sup> Deaton (1998) notes that in Britain during 1975-76, when inflation rate was around 15 percent, the rate for the poor was two points higher than for the rich (p.43).

<sup>19</sup> Interestingly, the simulations also indicate that for higher inflation, the dispersion between low and high income cohorts in age groups 25-64 remains small, whereas the dispersion between low and high income cohorts in the less than 25 age group increases significantly.

Table 5. Income Bias Among Age Cohorts 1/ 2/  
(Cumulative CPI-W Inflation, 1986/87-1994/95)

|  | Age groups (Years) |         |        |        |         |         |        |
|--|--------------------|---------|--------|--------|---------|---------|--------|
|  | < 25               | 25-34   | 35-44  | 45-54  | 55-64   | 65-74   | 75+    |
|  | (In percent)       |         |        |        |         |         |        |
| <u>Income groups (\$1,000)</u>   |                    |         |        |        |         |         |        |
| < 5  | 1.8 **             | 0.1     | 0.5 ** | -0.1   | 0.4     | 1.0 *   | 0.6    |
| 5-9.9  | 0.2                | -0.1    | -0.3 * | -0.3   | 1.0 **  | 0.9 *   | 0.4    |
| 10-14.9  | -0.2               | 0.4 **  | 0.2    | 0.4 *  | 0.7 **  | 0.1     | -0.2   |
| 15-19.9  | -0.6               | 0.0     | 1.0 ** | 1.3 ** | 0.7 **  | 0.4     | 0.6    |
| 20-29.9  | -0.6               | 0.4 **  | 0.3 *  | 0.4 *  | 0.1     | -0.8    | 0.7    |
| 30-39.9  | -0.3               | 0.1     | 0.0    | -0.1   | 0.0     | -0.1    | -2.0   |
| 40-49.9  | -0.5               | -0.2 ** | -0.2   | -0.2   | -0.7 ** | -0.7    | -1.3   |
| 50+  | -0.8               | -0.5 ** | -0.2   | -0.2   | -0.6 *  | -1.2 ** | -3.2 * |
| Memorandum item:   |                    |         |        |        |         |         |        |
| Estimated CPI-W inflation for<br>all households minus<br>Estimated overall CPI-W inflation | 0.3                | -0.4    | 0.0    | 0.6    | 1.2     | 2.4     | 4.1    |

Source: Authors' estimates.

Table 6. Significance Tests for Income Bias Among  
Age Cohorts and Age Bias Among Income Cohorts  
(Cumulative CPI-W Inflation, 1986/87-1994/95)

|                      | MS  | F*        |
|----------------------|-----|-----------|
| Factor A: Income     | 2.0 | 5.2 ** 1/ |
| Factor B: Age        | 0.5 | 1.4       |
| MSE                  | 0.4 |           |
| Memorandum items:    |     |           |
| <u>F-Values</u>      |     |           |
| Income: F(99; 7, 42) |     | 3.1       |
| Age: F(95; 6, 42)    |     | 2.3       |

Source: Authors' estimates.

1/ Significant at 99 percent level.

#### IV. CONCLUSION

As acknowledged by the Boskin Commission Report and in the subsequent rebuttal by the Report's authors (1998), further research is needed to ascertain if income and age biases in CPI measurement are present and significant. We presented some evidence that an across-the-board downward adjustment in CPI might not be neutral.<sup>20</sup> It could potentially affect more adversely the lower income elderly households, the primary beneficiaries of COLA, and result in a deterioration in income distribution against those households. Further research based on more comprehensive BLS data bases may provide for (or remove) economically reasonable grounds for separate COLAs for households in different income brackets and age groups, just as there are reasonable grounds for graduated income tax rates for higher income brackets regardless of age.

However, a stratification of budgetary COLA across income and age cohorts could reduce CPI biases but it would not eliminate them within cohort groups. Since such a stratification would likely increase the complexity (and possibly reduce fiscal transparency) of COLA, implementation costs could be high.

Finally, our results do not detract from the recommendations of the Boskin Commission Report, the CBO and others to improve the CPI measurement and correct the possible upward bias in budgetary COLA granted on the basis of the CPI.<sup>21</sup> A correction in current CPI measurement is critical because of its large impact on the Federal budget. However, although a downward adjustment in the CPI can generate substantial budgetary savings, it may also induce significant distortions in income distribution among households and reduce the welfare of lower income and higher age groups disproportionately. Beyond the refinements and corrections that can be justified on purely technical grounds, the potentially uneven impact of a downward adjustment in the CPI on income distribution places this issue within the ongoing public debate on whether the skewness in income distribution in the U.S. is increasing. In this debate, the accuracy of CPI measurement plays a central role. In our view, this aspect of a downward adjustment in the CPI deserves as close a scrutiny as the factors that may result in an overstated CPI. As appropriately underscored by the Boskin Commission Report (p. 85), such scrutiny is particularly warranted if the purpose of CPI-based COLA is *"to fully and accurately insulate the groups receiving transfer payments and paying taxes, no more no less."*

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<sup>20</sup> *The Washington Post* reported (April 17, 1998) that the BLS announced (April 16) a downward adjustment in CPI to correct for the substitution bias.

<sup>21</sup> Undoubtedly, such improvements in the CPI measurement are as imperative as the potential statistical improvements in the measurement of other key economic variables such as national income, unemployment rate, external current account, so on.

## EXPLANATION OF EXPENDITURE AND PRICE INDEX DATA

### 1. Expenditure classification

Although the official CPI market basket weights are based on the CES samples, the CPI expenditure classification differs from the classification used in the CES in important respects. At the major expenditure category level used in this study, the main differences are in the classification and measurement of expenditures on *housing* and *transportation*. Under *housing*, (i) for homeowners, the major shelter component of the CPI-W is “owner’s equivalent rent”, whereas in the CES shelter is defined as mortgage interest, property taxes, and maintenance, repairs, insurance and other expenses; (ii) the CPI-W weights for major appliances (for example, refrigerators and stoves) and maintenance and repair commodities and services by homeowners are “rental equivalenced” to the probability that a similar renter would incur the expense, whereas the CES data reports the actual expenses incurred; (iii) expenditures for homeowner’s insurance in the CPI-W are adjusted to reflect only the portion that covers personal property. Under *transportation*, (i) CPI-W defines the purchase of a new vehicle as the purchase price, while in the CES it is the net outlay (purchase price minus any trade-in allowance); (ii) for used vehicles, the CPI-W expenditures are defined as “dealer profit”. The CES data used in this paper to derive expenditure weights have *not* been adjusted for these differences.<sup>22</sup>

Furthermore, expenditure on “*televisions, radios, sound equipment*” is classified under housing expenditure in the CPI-W market basket weights, whereas it is included in the entertainment category in the CES; expenditure on “*reading*” is classified under entertainment expenditure in the CPI-W market basket weights, whereas it is included in the other expenditure category in the CES. The CES data used in this paper to derive expenditure weights have been adjusted to account for these latter differences. The expenditure classification used in this paper in order to calculate expenditure weights is presented and compared to the CES classification in Table 7.

### 2. Expenditure definition

The official CPI market basket weights published in *Relative Importances* represents the percent distribution of the cost of the fixed CPI market basket at a point in time. For example, December 1986 CPI market basket weights represent the average 1982-84 weights updated to December 1986 prices. On the other hand, the expenditure weights calculated on the basis of the CES data represent calendar year annual expenditures in 1986 as a whole. Thus, the CPI-W December 1986 market basket weights do not reflect the substitutions that may have occurred between 1982-84 and December 1986 due to changes in relative prices, whereas the 1986 CES data reflect the observed consumption in 1986.

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<sup>22</sup> We do not have access to the extended BLS databases necessary to establish the exact concordances between the *Relative Importances* and CES classifications of expenditures.

### 3. Population definition

The population for CPI-U is *all urban consumers*, which consists of all urban households in the metropolitan statistical areas (MSAs) and in other urban places of 2,500 or more inhabitants. Nonfarm consumers living in rural areas within the MSAs are included but the index excludes rural consumers and all military and institutional population. The population for the CPI-W is a subset of the population for the CPI-U. The CPI-W population of *urban wage earners and clerical workers* consists of consumer units with clerical workers, sales workers, craft workers, operators, service workers, and laborers. To qualify for the CPI-W population, more than one-half of the consumer unit's income has to be earned from and at least one of the members of the consumer unit must be employed for 37 weeks or more in the above eligible occupations.

On the other hand, the CES expenditure data represent the total civilian U.S. non-institutional population. Thus, there are two major differences between the CPI-W population coverage and the CES households: (i) the CES sample includes rural households; (ii) the CES sample is not limited to wage earners and clerical workers.

### 4. Definition of the price index used in Equations (1)-(5)

In (1)-(5),  $P_{i,t}$  is the *simple average* of the price indexes for the twelve months in a given year  $t$ , starting as of 1986. The official CPI-W inflation during 1986-95 is calculated as the average 1982-84 CPI market basket weights *adjusted* by *December price index* reported in a given year during the period 1986-95. However, in this study, inflation during 1986-95 is estimated by taking the official December 1986 CPI market basket weights and adjusting them by the *12-month average price index* for a given year during the period 1986-95 (Table 2). Thus, in Table 2, there is a small difference between the estimated CPI inflation (line 1) and the actual or official CPI inflation during 1986-95 (line 2). We use the *12-month average price index* for the reason that the weights based on CES data reflect the yearly average weights for the major expenditure categories, comparable to the *12-month average price index*.

Box 1. Composition of CES Data on Expenditure of  
Income and Age Cohorts, 1986-95

| <b>Income cohorts (dollars per year)</b> | <b>Age cohorts (years)</b>       |
|--|----------------------------------|
| All households (all income cohorts)      | All households (all age cohorts) |
| Less than 5,000                          | Less than 25                     |
| 5,000-9,999                              | 25-34                            |
| 10,000-14,999                            | 35-44                            |
| 15,000-19,999                            | 45-54                            |
| 20,000-29,999                            | 55-64                            |
| 30,000-39,999                            | 65-74                            |
| 40,000-49,999                            | 75 and above                     |
| 50,000 and above                         |                                  |

Box 2. Composition of CES Data on Expenditure by Income Cohorts  
in Different Age Groups, 1986/87-1994/95

| <b>Ages less than 25</b>               | ..... | <b>Ages 75 and above</b>               |
|--|-------|--|
| All households (all income cohorts)    | ..... | All households (all income cohorts)    |
| <u>Income level (dollars per year)</u> |       | <u>Income level (dollars per year)</u> |
| Less than 5,000                        | ..... | Less than 5,000                        |
| 5,000-9,999                            | ..... | 5,000-9,999                            |
| 10,000-14,999                          | ..... | 10,000-14,999                          |
| 15,000-19,999                          | ..... | 15,000-19,999                          |
| 20,000-29,999                          | ..... | 20,000-29,999                          |
| 30,000-39,999                          | ..... | 30,000-39,999                          |
| 40,000-49,999                          | ..... | 40,000-49,999                          |
| 50,000 and above                       | ..... | 50,000 and above                       |

Table 7. CES and This Study's Classification of Household Expenditures

| CES Classification of Household Expenditures   | Classification of Household Expenditures Used in This Study for Estimation   |
|--|--|
| <p><b>Average annual expenditures</b></p> <p><b>(a) Food</b></p> <p><b>(b) Alcoholic beverages</b></p> <p><b>(c) Housing</b></p> <p>Shelter</p> <p>Utilities, fuels, and public services</p> <p>Household operations</p> <p>Housekeeping supplies</p> <p>Household furnishings and equipment</p> <p>Household textiles</p> <p>Furniture</p> <p>Floor coverings</p> <p>Major appliances</p> <p>Small appliances, miscellaneous housewares</p> <p>Miscellaneous household equipment</p> <p><b>(d) Apparel and services</b></p> <p><b>(e) Transportation</b></p> <p><b>(f) Health care</b></p> <p><b>(g) Entertainment</b></p> <p>Fees and admissions</p> <p><b>Television, radios, sound equipment</b></p> <p>Pets, toys, and playground equipment</p> <p>Other ent. sup., equip., and services</p> <p><b>(h) Other goods and services</b></p> <p>Personal care products and services</p> <p><b>Reading</b></p> <p>Education</p> <p>Tobacco products and smoking supplies</p> <p>Miscellaneous</p> | <p><b>Average annual expenditures</b></p> <p><b>(a) Food and Alcoholic Beverages</b></p> <p><b>Alcoholic beverages</b></p> <p><b>(b) Housing</b></p> <p>Shelter</p> <p>Utilities, fuels, and public services</p> <p>Household operations</p> <p>Housekeeping supplies</p> <p>Household furnishings and equipment</p> <p>Household textiles</p> <p>Furniture</p> <p>Floor coverings</p> <p>Major appliances</p> <p>Small appliances, miscellaneous housewares</p> <p>Miscellaneous household equipment</p> <p><b>Television, radios, sound equipment</b></p> <p><b>(c) Apparel and services</b></p> <p><b>(d) Transportation</b></p> <p><b>(e) Health care</b></p> <p><b>(f) Entertainment</b></p> <p>Fees and admissions</p> <p><b>Reading</b></p> <p>Pets, toys, and playground equipment</p> <p>Other ent. sup., equip., and services</p> <p><b>(g) Other goods and services</b></p> <p>Personal care products and services</p> <p>Education</p> <p>Tobacco products and smoking supplies</p> <p>Miscellaneous</p> |

Source: CES and the authors' reclassification.

Table 8. Expenditure Weights of Income Cohorts, 1986, 1986/87

|                                  | All<br>households | Income cohorts (\$1,000 per year) |       |         |         |         |         |         |       |
|----------------------------------|-------------------|-----------------------------------|-------|---------|---------|---------|---------|---------|-------|
|                                  |                   | < 5                               | 5-9.9 | 10-14.9 | 15-19.9 | 20-29.9 | 30-39.9 | 40-49.9 | 50 +  |
| <u>1986</u>                      |                   |                                   |       |         |         |         |         |         |       |
| Total                            | 100.0             | 100.0                             | 100.0 | 100.0   | 100.0   | 100.0   | 100.0   | 100.0   | 100.0 |
| (a) Food and alcoholic beverages | 17.9              | 17.9                              | 19.7  | 18.8    | 18.4    | 18.9    | 17.8    | 17.5    | 16.0  |
| (b) Housing                      | 36.3              | 38.7                              | 38.9  | 36.5    | 36.5    | 35.0    | 34.9    | 35.8    | 36.8  |
| (c) Apparel and upkeep           | 6.5               | 5.3                               | 6.2   | 5.8     | 5.2     | 6.3     | 7.0     | 6.7     | 7.3   |
| (d) Transportation               | 22.9              | 19.9                              | 17.9  | 21.2    | 22.0    | 23.9    | 24.3    | 25.3    | 23.9  |
| (e) Medical care                 | 5.4               | 6.6                               | 7.7   | 7.4     | 7.3     | 5.6     | 4.5     | 4.0     | 4.1   |
| (f) Entertainment                | 4.4               | 3.7                               | 2.9   | 3.2     | 4.4     | 4.3     | 5.0     | 4.7     | 5.2   |
| (g) Other goods and services     | 6.6               | 7.7                               | 6.6   | 7.1     | 6.4     | 6.1     | 6.6     | 6.0     | 6.8   |
| <u>1986/87</u>                   |                   |                                   |       |         |         |         |         |         |       |
| Total                            | 100.0             | 100.0                             | 100.0 | 100.0   | 100.0   | 100.0   | 100.0   | 100.0   | 100.0 |
| (a) Food and alcoholic beverages | 18.3              | 18.9                              | 20.1  | 19.4    | 18.8    | 19.2    | 18.0    | 17.8    | 16.6  |
| (b) Housing                      | 36.4              | 39.2                              | 39.1  | 36.5    | 36.3    | 35.1    | 35.0    | 35.7    | 37.3  |
| (c) Apparel and upkeep           | 6.6               | 5.3                               | 5.9   | 6.1     | 5.6     | 6.4     | 7.2     | 6.7     | 7.3   |
| (d) Transportation               | 22.1              | 18.5                              | 16.8  | 21.1    | 21.2    | 23.2    | 23.4    | 24.7    | 22.5  |
| (e) Medical care                 | 5.3               | 6.3                               | 8.3   | 7.1     | 7.0     | 5.5     | 4.6     | 4.2     | 4.0   |
| (f) Entertainment                | 4.5               | 3.5                               | 2.9   | 3.2     | 4.6     | 4.1     | 5.0     | 4.8     | 5.4   |
| (g) Other goods and services     | 6.8               | 8.3                               | 6.9   | 6.7     | 6.4     | 6.6     | 6.8     | 6.3     | 7.0   |
| Memorandum items:                |                   |                                   |       |         |         |         |         |         |       |
| 1986                             |                   |                                   |       |         |         |         |         |         |       |
| Number of consumer units 1/      | 84565             | 10357                             | 13461 | 10587   | 8654    | 14093   | 10617   | 6509    | 10286 |
| Number of sample interviews 1/   | 34761             | 3898                              | 5331  | 4284    | 3544    | 5959    | 4433    | 2877    | 4435  |
| 1987                             |                   |                                   |       |         |         |         |         |         |       |
| Number of consumer units 1/      | 81070             | 7497                              | 12490 | 10410   | 8386    | 14175   | 10439   | 7150    | 10524 |
| Number of sample interviews 1/   | 35195             | 3007                              | 5200  | 4305    | 3646    | 6139    | 4831    | 3253    | 4814  |

Source: Adjusted CES data.

1/ Complete income reporters only.



Table 9. Expenditure Weights of Age Cohorts, 1986, 1986/87

|                                  | All<br>households | Age cohorts |       |       |       |       |       |       |
|----------------------------------|-------------------|-------------|-------|-------|-------|-------|-------|-------|
|                                  |                   | <25         | 25-34 | 35-44 | 45-54 | 55-64 | 65-74 | 75+   |
| <u>1986</u>                      |                   |             |       |       |       |       |       |       |
| Total                            | 100.0             | 100.0       | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| (a) Food and alcoholic beverages | 17.7              | 18.5        | 17.3  | 17.6  | 18.1  | 17.7  | 17.7  | 17.7  |
| (b) Housing                      | 36.5              | 34.4        | 38.6  | 37.2  | 34.5  | 34.5  | 36.0  | 39.9  |
| (c) Apparel and upkeep           | 6.4               | 6.3         | 6.7   | 7.0   | 6.8   | 6.3   | 4.8   | 4.1   |
| (d) Transportation               | 23.1              | 25.2        | 23.9  | 22.7  | 24.8  | 23.7  | 20.9  | 14.3  |
| (e) Medical care                 | 5.4               | 2.8         | 3.5   | 3.9   | 4.5   | 6.8   | 10.5  | 16.3  |
| (f) Entertainment                | 4.4               | 3.6         | 4.2   | 5.1   | 4.2   | 4.4   | 4.2   | 2.8   |
| (g) Other goods and services     | 6.5               | 9.2         | 5.9   | 6.5   | 7.1   | 6.6   | 5.9   | 5.0   |
| <u>1986/87</u>                   |                   |             |       |       |       |       |       |       |
| Total                            | 100.0             | 100.0       | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| (a) Food and alcoholic beverages | 18.1              | 18.6        | 17.8  | 17.9  | 18.2  | 18.3  | 18.0  | 18.6  |
| (b) Housing                      | 36.7              | 34.3        | 39.1  | 37.3  | 34.6  | 34.8  | 36.1  | 40.6  |
| (c) Apparel and upkeep           | 6.6               | 6.5         | 6.7   | 7.1   | 7.0   | 6.3   | 5.5   | 4.5   |
| (d) Transportation               | 22.2              | 25.3        | 22.5  | 22.1  | 23.9  | 23.2  | 20.0  | 13.4  |
| (e) Medical care                 | 5.3               | 2.6         | 3.5   | 3.9   | 4.6   | 6.5   | 10.1  | 15.3  |
| (f) Entertainment                | 4.4               | 3.7         | 4.5   | 5.0   | 4.3   | 4.2   | 4.4   | 2.7   |
| (g) Other goods and services     | 6.7               | 9.0         | 6.0   | 6.6   | 7.6   | 6.7   | 6.0   | 4.9   |
| Memorandum items:                |                   |             |       |       |       |       |       |       |
| 1986                             |                   |             |       |       |       |       |       |       |
| Number of consumer units         | 94044             | 8849        | 21833 | 18175 | 12670 | 13201 | 10832 | 8485  |
| Number of sample interviews      | 40188             | 3867        | 9435  | 8152  | 5374  | 5417  | 4690  | 3253  |
| 1987                             |                   |             |       |       |       |       |       |       |
| Number of consumer units         | 94150             | 7811        | 21345 | 18747 | 13395 | 13080 | 11578 | 8194  |
| Number of sample interviews      | 41925             | 3558        | 9551  | 8595  | 6021  | 5847  | 4898  | 3455  |

Source: Adjusted CES data.

Table 10. Expenditure Weights of Income Cohorts in Different Age Groups, 1986/87

|                                  | All households | Income cohorts (in \$1,000 per year) |       |         |         |         |         |         |       |
|----------------------------------|----------------|--------------------------------------|-------|---------|---------|---------|---------|---------|-------|
|                                  |                | <5                                   | 5-9.9 | 10-14.9 | 15-19.9 | 20-29.9 | 30-39.9 | 40-49.9 | 50+   |
| <u>Ages less than 25</u>         |                |                                      |       |         |         |         |         |         |       |
| Total                            | 100.0          | 100.0                                | 100.0 | 100.0   | 100.0   | 100.0   | 100.0   | 100.0   | 100.0 |
| (a) Food and alcoholic beverages | 18.8           | 21.3                                 | 20.3  | 17.4    | 17.9    | 17.8    | 16.1    | 17.9    | 15.3  |
| (b) Housing                      | 33.8           | 31.4                                 | 32.8  | 32.7    | 36.4    | 35.3    | 35.0    | 33.6    | 37.0  |
| (c) Apparel and upkeep           | 6.5            | 8.7                                  | 6.2   | 7.4     | 5.6     | 5.3     | 6.3     | 5.0     | 5.5   |
| (d) Transportation               | 25.6           | 15.9                                 | 25.1  | 28.1    | 26.8    | 28.7    | 28.3    | 30.3    | 29.4  |
| (e) Medical care                 | 2.6            | 2.0                                  | 2.2   | 2.4     | 2.7     | 3.3     | 3.9     | 2.2     | 2.0   |
| (f) Entertainment                | 3.7            | 4.5                                  | 3.4   | 3.3     | 4.0     | 3.6     | 3.9     | 3.8     | 3.6   |
| (g) Other goods and services     | 9.0            | 16.3                                 | 10.2  | 8.9     | 6.6     | 5.8     | 6.5     | 7.2     | 7.3   |
| Number of consumer units         | 7537           | 2302                                 | 1654  | 1112    | 888     | 970     | 392     | 123     | 96    |
| Number of sample interviews      | 6539           | 1982                                 | 1398  | 955     | 788     | 847     | 366     | 118     | 85    |
| <u>Ages 25-34</u>                |                |                                      |       |         |         |         |         |         |       |
| Total                            | 100.0          | 100.0                                | 100.0 | 100.0   | 100.0   | 100.0   | 100.0   | 100.0   | 100.0 |
| (a) Food and alcoholic beverages | 17.9           | 20.3                                 | 21.2  | 19.4    | 19.4    | 18.7    | 17.1    | 16.5    | 15.5  |
| (b) Housing                      | 38.7           | 38.2                                 | 40.0  | 38.8    | 39.7    | 36.9    | 38.2    | 38.6    | 41.5  |
| (c) Apparel and upkeep           | 6.8            | 4.7                                  | 7.7   | 6.0     | 6.1     | 6.7     | 6.6     | 6.6     | 7.9   |
| (d) Transportation               | 22.4           | 23.7                                 | 18.2  | 21.9    | 20.7    | 22.9    | 23.1    | 24.7    | 21.3  |
| (e) Medical care                 | 3.5            | 2.7                                  | 2.7   | 3.6     | 3.9     | 3.9     | 3.3     | 3.6     | 3.4   |
| (f) Entertainment                | 4.5            | 3.7                                  | 2.9   | 3.2     | 4.6     | 4.3     | 5.1     | 4.7     | 5.4   |
| (g) Other goods and services     | 6.1            | 6.7                                  | 7.3   | 7.1     | 5.6     | 6.6     | 6.5     | 5.3     | 5.1   |
| Number of consumer units         | 19415          | 1322                                 | 1922  | 2374    | 2381    | 4542    | 3073    | 1879    | 1923  |
| Number of sample interviews      | 16634          | 987                                  | 1612  | 1878    | 1997    | 3902    | 2827    | 1711    | 1720  |
| <u>Ages 35-44</u>                |                |                                      |       |         |         |         |         |         |       |
| Total                            | 100.0          | 100.0                                | 100.0 | 100.0   | 100.0   | 100.0   | 100.0   | 100.0   | 100.0 |
| (a) Food and alcoholic beverages | 18.2           | 16.3                                 | 21.3  | 18.6    | 20.0    | 20.1    | 18.6    | 18.2    | 16.1  |
| (b) Housing                      | 36.9           | 40.2                                 | 39.0  | 37.1    | 36.0    | 35.5    | 34.5    | 36.9    | 38.7  |
| (c) Apparel and upkeep           | 7.1            | 5.7                                  | 8.0   | 6.7     | 5.7     | 6.6     | 7.6     | 7.1     | 7.3   |
| (d) Transportation               | 22.0           | 22.2                                 | 18.3  | 22.6    | 20.7    | 21.8    | 23.3    | 22.6    | 21.8  |
| (e) Medical care                 | 3.9            | 4.8                                  | 3.5   | 4.4     | 5.7     | 4.4     | 4.1     | 3.6     | 3.4   |
| (f) Entertainment                | 5.1            | 3.8                                  | 3.1   | 3.8     | 4.6     | 4.6     | 5.4     | 5.1     | 5.8   |
| (g) Other goods and services     | 6.8            | 6.9                                  | 6.9   | 6.7     | 7.3     | 6.9     | 6.4     | 6.6     | 6.9   |
| Number of consumer units         | 16251          | 953                                  | 1172  | 1320    | 1315    | 3058    | 2980    | 2188    | 3264  |
| Number of sample interviews      | 14297          | 718                                  | 1010  | 1050    | 1193    | 2591    | 2662    | 2013    | 3060  |

Table 10. Expenditure Weights of Income Cohorts in Different Age Groups, 1986/87 (continued)

|                                  | All households | Income cohorts (in \$1,000 per year) |       |         |         |         |         |         |       |
|----------------------------------|----------------|--------------------------------------|-------|---------|---------|---------|---------|---------|-------|
|                                  |                | < 5                                  | 5-9.9 | 10-14.9 | 15-19.9 | 20-29.9 | 30-39.9 | 40-49.9 | 50 +  |
| <u>Ages 45-54</u>                |                |                                      |       |         |         |         |         |         |       |
| Total                            | 100.0          | 100.0                                | 100.0 | 100.0   | 100.0   | 100.0   | 100.0   | 100.0   | 100.0 |
| (a) Food and alcoholic beverages | 18.3           | 17.9                                 | 21.3  | 20.9    | 16.0    | 19.6    | 18.0    | 18.1    | 17.5  |
| (b) Housing                      | 34.3           | 39.2                                 | 38.3  | 38.9    | 34.6    | 33.2    | 32.4    | 33.3    | 34.6  |
| (c) Apparel and upkeep           | 7.0            | 5.7                                  | 6.4   | 4.4     | 5.6     | 6.7     | 7.7     | 6.7     | 7.4   |
| (d) Transportation               | 23.6           | 20.6                                 | 20.0  | 19.9    | 25.0    | 23.8    | 24.8    | 25.6    | 23.6  |
| (e) Medical care                 | 4.5            | 4.5                                  | 5.1   | 5.8     | 7.5     | 5.3     | 4.5     | 4.4     | 3.8   |
| (f) Entertainment                | 4.4            | 4.6                                  | 2.7   | 3.1     | 3.4     | 3.3     | 5.1     | 4.9     | 4.8   |
| (g) Other goods and services     | 7.8            | 7.4                                  | 6.2   | 7.1     | 7.8     | 8.1     | 7.5     | 7.0     | 8.4   |
| Number of consumer units         | 11034          | 787                                  | 905   | 962     | 778     | 1894    | 1721    | 1427    | 2560  |
| Number of sample interviews      | 9313           | 558                                  | 734   | 763     | 669     | 1619    | 1491    | 1141    | 2338  |
| <u>Ages 55-64</u>                |                |                                      |       |         |         |         |         |         |       |
| Total                            | 100.0          | 100.0                                | 100.0 | 100.0   | 100.0   | 100.0   | 100.0   | 100.0   | 100.0 |
| (a) Food and alcoholic beverages | 18.6           | 20.1                                 | 18.7  | 20.0    | 20.7    | 19.1    | 19.7    | 18.7    | 16.6  |
| (b) Housing                      | 34.3           | 39.6                                 | 37.8  | 33.1    | 34.6    | 32.2    | 32.3    | 31.0    | 35.6  |
| (c) Apparel and upkeep           | 6.5            | 4.3                                  | 5.6   | 6.9     | 5.8     | 6.4     | 6.7     | 6.5     | 7.0   |
| (d) Transportation               | 23.0           | 19.2                                 | 18.9  | 21.6    | 20.4    | 24.8    | 23.6    | 28.3    | 23.3  |
| (e) Medical care                 | 6.5            | 7.6                                  | 8.9   | 8.7     | 8.2     | 6.7     | 6.0     | 5.0     | 5.0   |
| (f) Entertainment                | 4.2            | 2.6                                  | 3.0   | 3.1     | 3.5     | 4.1     | 4.3     | 4.5     | 5.4   |
| (g) Other goods and services     | 6.8            | 6.7                                  | 7.1   | 6.6     | 6.8     | 6.6     | 7.3     | 6.1     | 7.1   |
| Number of consumer units         | 11270          | 1226                                 | 1626  | 1338    | 1153    | 1856    | 1413    | 771     | 1886  |
| Number of sample interviews      | 9249           | 927                                  | 1268  | 1162    | 910     | 1552    | 1186    | 737     | 1507  |
| <u>Ages 65-74</u>                |                |                                      |       |         |         |         |         |         |       |
| Total                            | 100.0          | 100.0                                | 100.0 | 100.0   | 100.0   | 100.0   | 100.0   | 100.0   | 100.0 |
| (a) Food and alcoholic beverages | 18.5           | 18.4                                 | 19.3  | 19.1    | 18.2    | 18.8    | 16.8    | 18.8    | 18.0  |
| (b) Housing                      | 35.6           | 42.4                                 | 39.2  | 35.5    | 32.6    | 34.6    | 35.4    | 30.5    | 34.5  |
| (c) Apparel and upkeep           | 5.5            | 3.4                                  | 4.9   | 5.7     | 5.8     | 5.4     | 6.6     | 6.6     | 5.7   |
| (d) Transportation               | 19.7           | 14.5                                 | 14.5  | 20.0    | 19.6    | 23.2    | 20.3    | 24.6    | 22.6  |
| (e) Medical care                 | 10.2           | 13.3                                 | 12.4  | 10.6    | 10.8    | 9.0     | 9.0     | 7.5     | 7.4   |
| (f) Entertainment                | 4.4            | 2.5                                  | 3.4   | 3.2     | 6.7     | 4.2     | 4.5     | 5.0     | 6.2   |
| (g) Other goods and services     | 6.1            | 5.4                                  | 6.2   | 5.9     | 6.4     | 4.9     | 7.5     | 7.0     | 5.6   |
| Number of consumer units         | 9937           | 1067                                 | 2736  | 2031    | 1329    | 1185    | 760     | 323     | 505   |
| Number of sample interviews      | 8192           | 827                                  | 2208  | 1652    | 1109    | 1084    | 584     | 309     | 419   |

Table 10. Expenditure Weights of Income Cohorts in Different Age Groups, 1986/87 (concluded)

|                                   | All<br>households | Income cohorts (in \$1,000 per year) |       |         |                          |         |         |         |       |       |
|-----------------------------------|-------------------|--------------------------------------|-------|---------|--------------------------|---------|---------|---------|-------|-------|
|                                   |                   | < 5                                  | 5-9.9 | 10-14.9 | 15-19.9                  | 20-29.9 | 30-39.9 | 40-49.9 | 50 +  |       |
|                                   |                   |                                      |       |         | <u>Ages 75 and above</u> |         |         |         |       |       |
| Total                             | 100.0             | 100.0                                | 100.0 | 100.0   | 100.0                    | 100.0   | 100.0   | 100.0   | 100.0 | 100.0 |
| (a) Food and alcoholic beverages  | 19.2              | 20.0                                 | 19.4  | 20.9    | 16.9                     | 19.3    | 16.1    | 16.5    | 22.2  |       |
| (b) Housing                       | 39.8              | 46.5                                 | 44.0  | 38.4    | 38.8                     | 34.1    | 35.1    | 36.9    | 32.5  |       |
| (c) Apparel and upkeep            | 4.3               | 3.4                                  | 4.1   | 4.8     | 3.0                      | 5.0     | 8.8     | 4.1     | 5.2   |       |
| (d) Transportation                | 13.6              | 6.4                                  | 9.0   | 13.7    | 15.5                     | 16.9    | 20.4    | 21.1    | 24.7  |       |
| (e) Medical care                  | 15.3              | 17.1                                 | 16.4  | 15.0    | 16.9                     | 17.2    | 10.5    | 10.6    | 7.5   |       |
| (f) Entertainment                 | 2.8               | 1.8                                  | 2.0   | 2.4     | 4.5                      | 3.0     | 3.4     | 4.4     | 3.6   |       |
| (g) Other goods and services      | 5.0               | 4.8                                  | 5.1   | 5.0     | 4.3                      | 4.6     | 5.6     | 6.5     | 4.2   |       |
| Number of consumer units          | 7373              | 1270                                 | 2960  | 1362    | 676                      | 629     | 188     | 118     | 171   |       |
| Number of sample interviews       | 5732              | 906                                  | 2301  | 1129    | 524                      | 503     | 148     | 101     | 120   |       |
| Memorandum items:                 |                   |                                      |       |         |                          |         |         |         |       |       |
| Total number of consumer units    | 82817             | 8927                                 | 12975 | 10499   | 8520                     | 14134   | 10527   | 6829    | 10405 |       |
| Total number of sample interviews | 69956             | 6905                                 | 10531 | 8589    | 7190                     | 12098   | 9264    | 6130    | 9249  |       |

Sources: CES and the authors' calculations.

Table 11. Estimated Overall CPI-W Inflation Excluding  
a Given Category of Expenditure and Actual CPI-W Inflation  
(Cumulative, 1986-95, 1986/87-1994/95)

|   | CPI Code 1/ | 1986-95 | 1986/87-<br>1994/95 |
|---|-------------|---------|---------------------|
| (In percent)  |             |         |                     |
| Estimated CPI-W inflation including<br><u>all categories of expenditure</u> | SA0         | 38.0    | 33.7                |
| <u>Estimated CPI-W inflation excluding:</u>                                 |             |         |                     |
| (a) Food and alcoholic beverages  | SA1         | 38.5    | 34.2                |
| (b) Housing   | SA2         | 41.7    | 36.7                |
| (c) Apparel and upkeep  | SA3         | 39.0    | 34.5                |
| (d) Transportation  | SA4         | 38.4    | 34.2                |
| (e) Medical care  | SA5         | 35.9    | 31.8                |
| (f) Entertainment   | SA6         | 38.1    | 33.7                |
| (g) Other goods and services  | SA7         | 36.1    | 32.0                |
| <u>Actual CPI-W inflation 2/</u>  |             |         |                     |
| CPI-W   | SA0         | 37.9    | 33.6                |
| (a) Food and alcoholic beverages  | SA1         | 36.2    | 31.7                |
| (b) Housing   | SA2         | 32.5    | 29.2                |
| (c) Apparel and upkeep  | SA3         | 23.7    | 21.7                |
| (d) Transportation  | SA4         | 36.5    | 31.6                |
| (e) Medical care  | SA5         | 80.2    | 70.6                |
| (f) Entertainment   | SA6         | 36.8    | 32.9                |
| (g) Other goods and services  | SA7         | 68.9    | 61.1                |

Source: BLS and authors' estimates.

1/ The last three items in the BLS code for the CPI series  
(CWUR0000 \_ \_ \_).

2/ Actual BLS data.

Table 12. Deviation of Estimated Income Cohort CPI-W Inflation From Estimated CPI-W Inflation for All Households  
 Excluding Selected Expenditure Categories by Income Cohorts 1/ 2/  
 (Cumulative, 1986-95, 1986/87-1994/95)

|                                 | Excluding:  |                |                |                |                |                |              |
|---------------------------------|-------------|----------------|----------------|----------------|----------------|----------------|--------------|
|                                 | (a)<br>Food | (b)<br>Housing | (c)<br>Apparel | (d)<br>Transp. | (e)<br>Medical | (f)<br>Entert. | (g)<br>Other |
| (In percent)                    |             |                |                |                |                |                |              |
| <u>1986-95</u>                  |             |                |                |                |                |                |              |
| <u>Income cohorts (\$,1000)</u> |             |                |                |                |                |                |              |
| < 5                             | 1.2         | 0.1            | 0.8 *          | 1.1            | 0.4 **         | 1.0 *          | 0.6          |
| 5-9.9                           | 1.2         | 0.0            | 1.0 *          | 1.0            | -0.1 **        | 0.9 *          | 1.0 *        |
| 10-14.9                         | 1.4 *       | -0.5 **        | 1.1 **         | 1.4 *          | 0.3 **         | 1.1 *          | 1.0 *        |
| 15-19.9                         | 1.1         | 0.2 **         | 0.7            | 1.1            | 0.1 **         | 0.9 *          | 1.0 *        |
| 20-29.9                         | 0.0         | -0.3 **        | -0.1           | 0.0            | -0.1 **        | 0.0            | 0.1          |
| 30-39.9                         | -0.5        | 0.1 **         | -0.3           | -0.5           | 0.0            | -0.4           | -0.4         |
| 40-49.9                         | -1.0        | -0.3 **        | -0.8 *         | -1.0           | -0.2 **        | -0.8           | -0.6         |
| 50+                             | -0.8        | 0.3 **         | -0.5           | -0.8           | -0.1           | -0.6           | -0.7         |
| <u>1986/87-1994/9595</u>        |             |                |                |                |                |                |              |
| <u>Income cohorts (\$,1000)</u> |             |                |                |                |                |                |              |
| < 5                             | 1.1         | 1.8            | 0.7 *          | 0.9 *          | 0.5 **         | 0.9 *          | 0.5          |
| 5-9.9                           | 1.5 *       | 2.3 *          | 1.2 **         | 1.2 **         | 0.0            | 1.2 **         | 1.2 **       |
| 10-14.9                         | 0.9         | 1.1            | 0.7 *          | 0.8 *          | 0.0            | 0.7 *          | 0.8 *        |
| 15-19.9                         | 0.8         | 1.0            | 0.5            | 0.8            | 0.0            | 0.7            | 0.8 *        |
| 20-29.9                         | 0.1         | -0.1           | 0.0            | 0.1            | 0.0            | 0.1            | 0.1          |
| 30-39.9                         | -0.4        | -0.6           | -0.2           | -0.3           | 0.0            | -0.3           | -0.3         |
| 40-49.9                         | -0.7        | -1.0           | -0.6 *         | -0.7           | -0.1 **        | -0.6           | -0.5         |
| 50+                             | -0.7        | -0.8           | -0.5           | -0.7           | 0.0            | -0.6           | -0.7         |

Source: Authors' estimates.

1/ Estimated group CPI-W minus estimated all households CPI-W.

2/ (\*) and (\*\*) refer to t-test results at 10 and 5 percent levels of significance, respectively.

Table 13. Deviation of Estimated Age Cohort CPI-W Inflation From Estimated CPI-W Inflation for All Households  
 Excluding Selected Expenditure Categories 1/ 2/  
 (Cumulative, 1986-95, 1986/87-1994/95)

|                            | Excluding:             |                |                |                |                |                |              |
|----------------------------|------------------------|----------------|----------------|----------------|----------------|----------------|--------------|
|                            | (a)<br>Food            | (b)<br>Housing | (c)<br>Apparel | (d)<br>Transp. | (e)<br>Medical | (f)<br>Entert. | (g)<br>Other |
|                            | (In percent)           |                |                |                |                |                |              |
|                            | <u>1986-95</u>         |                |                |                |                |                |              |
| <u>Age cohorts (years)</u> |                        |                |                |                |                |                |              |
| < 25                       | -0.2                   | -0.6           | -0.2           | -0.2           | 1.0 **         | -0.2           | -1.2         |
| 25-34                      | -1.4                   | -1.6           | -1.2           | -1.5           | -0.3 *         | -1.2           | -1.0         |
| 35-44                      | -0.9                   | -1.1           | -0.7           | -1.0           | -0.1           | -0.8           | -0.8         |
| 45-54                      | -0.2                   | -0.6           | -0.1           | -0.2           | 0.2            | -0.2           | -0.4         |
| 55-64                      | 0.8                    | 0.8            | 0.7            | 0.9            | 0.1            | 0.7            | 0.7          |
| 65-74                      | 2.7                    | 3.4            | 2.1            | 2.7            | 0.0            | 2.3            | 2.6          |
| 75+                        | 5.4                    | 7.9            | 4.2            | 4.9            | -0.4 **        | 4.5            | 5.2          |
|                            | <u>1986/87-1994/95</u> |                |                |                |                |                |              |
| <u>Age cohorts (years)</u> |                        |                |                |                |                |                |              |
| < 25                       | -0.3                   | -0.8           | -0.3           | -0.3           | 0.8 **         | -0.3           | -1.1         |
| 25-34                      | -1.2                   | -1.3           | -1.0           | -1.2           | -0.3 **        | -1.0           | -0.8         |
| 35-44                      | -0.8                   | -0.9           | -0.6           | -0.8           | -0.1           | -0.6           | -0.7         |
| 45-54                      | 0.0                    | -0.3           | 0.0            | 0.0            | 0.3 **         | 0.0            | -0.3         |
| 55-64                      | 0.7                    | 0.6            | 0.5            | 0.7            | 0.1            | 0.6            | 0.6          |
| 65-74                      | 2.2                    | 2.7            | 1.7            | 2.2            | 0.0            | 1.9            | 2.1          |
| 75+                        | 4.3                    | 6.3            | 3.3 *          | 3.6            | -0.4 **        | 3.5            | 4.2          |

Source: Authors' estimates.

1/ Estimated group CPI-W minus estimated all households CPI-W.

2/ (\*) and (\*\*) refer to t-test results at 10 and 5 percent levels of significance, respectively.

Table 14. Hypothetical Example on Evaluating the Relative Significance of an Expenditure Component

| Expenditure weights (%)                  | Including |        |       | Excluding health |       |       | Excluding other |        |       |
|--|-----------|--------|-------|------------------|-------|-------|-----------------|--------|-------|
|  | Food      | Health | Other | Food             | Other | Total | Food            | Health | Total |
| All households                           | 30.0      | 30.0   | 40.0  | 42.9             | 57.1  | 100.0 | 50.0            | 50.0   | 100.0 |
| Group 1                                  | 40.0      | 20.0   | 40.0  | 50.0             | 50.0  | 100.0 | 66.7            | 33.3   | 100.0 |
| Group 2                                  | 20.0      | 40.0   | 40.0  | 33.3             | 66.7  | 100.0 | 33.3            | 66.7   | 100.0 |
| <u>CPI Indexes</u>                       |           |        |       |                  |       |       |                 |        |       |
| All households                           | 100.0     | 100.0  | 100.0 | 100.0            | 100.0 | 100.0 | 100.0           | 100.0  | 100.0 |
| Group 1                                  | 100.0     | 100.0  | 100.0 | 100.0            | 100.0 | 100.0 | 100.0           | 100.0  | 100.0 |
| Group 2                                  | 100.0     | 100.0  | 100.0 | 100.0            | 100.0 | 100.0 | 100.0           | 100.0  | 100.0 |
| <u>CPI Indexes</u>                       |           |        |       |                  |       |       |                 |        |       |
| All households                           | 140.0     | 170.0  | 140.0 | 140.0            | 140.0 | 149.0 | 140.0           | 170.0  | 155.0 |
| Group 1                                  | 140.0     | 170.0  | 140.0 | 140.0            | 140.0 | 146.0 | 140.0           | 170.0  | 150.0 |
| Group 2                                  | 140.0     | 170.0  | 140.0 | 140.0            | 140.0 | 152.0 | 140.0           | 170.0  | 160.0 |
| <u>Inflation dispersion, 1986-95 (%)</u> |           |        |       |                  |       |       |                 |        |       |
| Group 1- All households                  |           |        |       |                  |       | -3.0  |                 |        | -5.0  |
| Group 2- All households                  |           |        |       |                  |       | 3.0   |                 |        | 5.0   |

Source: Authors' calculations.



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