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Using Engel Curves to Estimate CPI Bias for the Elderly

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Abstract

We use shifts in food Engel curves among the U.S. elderly to estimate the extent of Consumer Price Index (CPI) bias specific to this population. Over the last thirty years the share of total expenditure devoted to food has declined more rapidly for elderly-headed households than for other households. This decline is not explained by a more rapid increase in measured total expenditure for the elderly, or by relative change in other covariates such as household composition. We present this as evidence that the true cost of living increased more slowly for the elderly than for the nonelderly over this period, in contrast to conventional wisdom that the elderly face a higher inflation rate.

JEL Codes: E31, J14
Keywords: Engel curve, CPI bias, cost of living, retirement, elderly

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1. Introduction

We study the living standards of older Americans to determine how well CPI changes reflect the cost of living. One claim about consumer price indices is that they understate the rate of increase of the cost of living for the elderly because the elderly consume a lot of healthcare, which is a sector that has seen faster than average price increases in recent decades (Hobijn and Lagakos, 2005). A policy implication of this view is that cost of living adjustments should be made at a rate different from the CPI inflation rate (Hobijn and Lagakos, 2003). An experimental index constructed by the Bureau of Labor Statistics suggests slightly higher inflation for retirees, 3.3% per year from 1982 to 2007 instead of 3.1% for all urban consumers (Stewart, 2008).

Our approach to measuring changes in the cost of living for the elderly follows Costa (2001) and Hamilton (2001b), who analyze the Engel curve relationship between the food budget share and the total spending of the household. Costa and Hamilton use the drift over time in the Engel curve as an indirect measure of changes in the true cost of living and hence of real income. We estimate how much this drift varies depending on whether the household has an elderly head. A comparison of differential shifts in the Engel curves of older and younger Americans shows if CPI bias is a bigger problem for the elderly. Nominal income (or total expenditure) in the Engel curve is deflated by a price index that could have trend bias. This bias shows up in shifts in food Engel curves over time and an analysis of the bias allows for an estimation of the true rate of progress of living standards. Food Engel curves remain stable over time if deflated income and food prices are held constant among households with similar demographic characteristics. Any shifts in Engel curves are then seen as bias in the consumer price index.

There are several reasons why the Consumer Price Index (CPI) does not accurately measure changes in the cost of living. One source of bias is substitution. Substitution bias causes a Laspeyres index to overstate the inflation rate, and is one argument for indexation of social security payments to be based on a chain-type index that presumably does a better job of accounting for substitution (Cage et al., 2003). Other reasons include the introduction of new goods, unmeasured quality improvements, and outlet bias. See Wynne and Sigalla (1996) or Hausman (2003) for more on these issues. See also the discussion of plutocratic and democratic weights in Pollak (1998) who observes that the market basket priced in the CPI reflects more closely the spending patterns of well-off households, rather than households near the middle of the income distribution.[1]

[1] Relatedly, Beatty and Crossley (2012) argue that the Engel curve method we use to estimate CPI bias is problematic. The drift in the Engel curve estimates actual changes in the cost of living for one household, but the CPI measures changes in the cost of living for a different household. Therefore, differences could emerge

The Boskin Commission (Boskin et al., 1997, 1998) estimated that the CPI contained an annual upward bias of between 0.8% to 1.6% per year, with a best guess of 1.1%. The Bureau of Labor Statistics made several improvements to its methods in the late 1990s, such as accounting for some substitution, changing the way it treated hospital charges and utilities refunds (General Accounting Office, 2000). In spite of this, Lebow and Rudd (2003) estimated an annual bias of around 0.9% (with a plausible range running from 0.3% to 1.4%).

Changes in the CPI depend on expenditure weights at the product level. Older people tend to spend more on health care, and measured healthcare costs have risen faster than the overall CPI in recent decades. Since the overall CPI underweights healthcare relative to seniors' budgets, a senior-specific price index might show faster increases in the cost of living, meaning the CPI is less biased for seniors than younger age-groups.[2] However, since seniors spend less on education, which also has increased rapidly in price, the sign and magnitude of the senior-bias in the CPI due to inappropriate weights is an empirical matter. The Bureau of Labor Statistics has published an experimental CPI (CPI-E) for the elderly and it does show slightly faster increases in the cost of living. But the CPI-E retains other aspects of the CPI that cause mismeasurement and that may differentially affect seniors, so there remains an open question about how closely the CPI tracks changes in the cost of living for older Americans.[3]

Our study is in the broader context of living standards among the elderly. Hurd (1990) surveys the historical progress of material well-being for older Americans, with extensive discussion of the role of social insurance programs in ameliorating poverty among the elderly. Several papers have discussed the behavior of household expenditures around the time of retirement. A robust finding is that household expenditures decline sharply at retirement. There are multiple possible interpretations for this fact. Banks et al. (1998) attempt to reconcile the drop in expenditures at retirement with the perma-

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if the inflation rate for these two households are generally different. We believe this critique is less relevant for our study, since we are comparing two groups of households, rather than estimating a single CPI bias over time. Also, see Hobijn and Lagakos (2005) for analysis that suggests the CPI inflation rate accurately represents changes in the cost of living for households at different parts of the income distribution over longer periods of time.

[2]Though note that measuring prices for medical care is difficult, as quality change is frequent, and new treatment methods are introduced. Cutler et al. (1998) argue that medical care has not been increasing in price as much as official statistics indicate once these considerations are accounted for. See also Triplett, ed (1999).

[3]As one example, Broda and Weinstein (2006) argue that the expanding variety of imported products coming into the United States from 1972 to 2001 was inadequately reflected in official import price indexes and that adjusting for the gains from variety would imply import prices rising about 1.2% less per year. If gains from variety are different for the elderly, this problem would not be addressed by simply reweighting the CPI.

nent income hypothesis by appealing to the possibility that households retire when they receive negative information about future earnings. Bernheim et al. (2001) argue for a behavioral explanation, such as rule-of-thumb consumers, or hyperbolic discounting.

Against these views, Aguiar and Hurst (2005) argue that the puzzle is nonexistent. They apply time use data to show that the decline in expenditures at retirement coincides with an increase in shopping time, interpreted as bargain hunting. (Aguiar and Hurst (2007) show that there is a life-cycle pattern for prices paid, and that prices paid are lower during retirement.) Moreover, diet quality and quantity remain comparable before and after retirement, as households increase household production as a complement to food purchases.

One policy justification for studying changes in the cost of living and how these relate to the CPI is that transfer payments are indexed to the price index. Some policy proposals would link transfers to the elderly to an elderly-specific price index, which has grown faster in recent years (Hobijn and Lagakos, 2003). Alternatively, indexing transfers to a slower-growing index reduces the government's fiscal deficit. Of course, this comes as a cost to beneficiaries whose transfer payments are reduced relative to the baseline. The Bowles-Simpson and Domenici-Rivlin plans for reducing the U.S. government's deficit both propose indexing social security payments to the chained CPI, with a one-time increase in the level of benefits as compensation for the slower presumed growth of payments. This kind of compensation means changing the indexation need not involve making the elderly worse off as a group.

The paper proceeds as follows. Section 2 describes the method we use to infer CPI bias, section 3 describes the consumer expenditure data we use, section 4 presents our results, and section 5 briefly discusses the effects of changing indexation of social security benefits.

2. Measuring Changes in the Cost of Living

Our paper is at the intersection of two literatures: measuring changes in the cost of living for the elderly, and inferring CPI bias from Engel curves. Hurd (1990) discusses the economic well-being of the elderly from a variety of perspectives. One of the main results he discusses is that, largely due to expanded social protection programs, poverty rates among the elderly fell substantially during the 20th century. Furthermore, the income gap between elderly and nonelderly households fell through the 1970s and 1980s.

Several studies have addressed the cost of living of the elderly by constructing new price indices that assign product weights closer to the expenditure weights of the elderly. Bridges and Packard (1981) find inflation to be 0.1 percentage points higher for the elderly from 1967 to 1979. Boskin and Hurd (1986) cover 1961 to 1981, and emphasize the treatment of housing in the construction of the price index, in addition to expenditure weights. They also find inflation rates to be slightly higher for the elderly than the nonelderly, but add the observation that by their calculations both groups face inflation substantially below the official CPI inflation rate. More recent studies have found larger discrepancies between the elderly and nonelderly. Amble and Stewart (1994) find inflation rates higher by 0.2 to 0.4 percentage points from 1987 to 1993 in the Bureau of Labor Statistics CPI-E. Hobijn and Lagakos (2005) find the elderly experience inflation that is 0.2 to 0.3 percentage points higher per year between 1987 and 2001, in line with Stewart (2008).

These studies all focus on measuring a price index with elderly-specific expenditure weights, but there are other reasons why price indices do not track the cost of living exactly, and these reasons might be more important for the elderly. For this reason, our study estimates changes in the cost of living using the Engel curve method. See Lewbel (2008) for a survey of Engel curve estimation. The basic idea is to estimate

$$\omega_{it}^{food} = \alpha + \beta(\log Y_{it} - \log P_t) + \delta_t + \epsilon_{it}$$

where ω^{food} measures food spending as a share of total spending for household i in period t, Y is the household's total nominal expenditure in that period with P the deflator, and δ_t is a shift in the intercept relative to the base year.[4] Assuming the reason the Engel curve drifts over time is measurement error in the price index, the dummy δ should represent $\beta(\log P_t - \log P_t^*)$ where P^* is the true cost of living. Therefore, the cumulated percentage deviation of the reported price index and the true cost of living in period t is computed as

$$100(exp(\delta_t/\beta) - 1).$$

Since our study separates the bias in the CPI for different groups, we estimate

$$\omega_{it}^{food} = \alpha + \beta(\log Y_{it} - \log P_t) + \delta_t + \delta_t^{elderly} D_{it}^{elderly} + \epsilon_{it}$$

where $D^{elderly}$ is an indicator for whether the head of household is elderly (usually de-

[4]This is the so-called Working-Leser functional form of the Engel curve. Since economic theory does not imply a specific functional form for the relationship between spending and income, some research examines whether alternative parametrizations are more appropriate. For example, Hausman et al. (1995) argue that the right-hand side should contain higher order terms in log expenditure for most Engel curves, though Banks et al. (1997) find that a linear specification is a good approximation when the outcome category is food.

fined as 62 or older). The cumulative bias for an elderly household is then

$$100(exp((\delta_t + \delta_t^{elderly})/\beta) - 1).$$

Shifts in food Engel curves have been used to estimate bias in price indices in many countries starting with Nakamura (1997), Hamilton (2001b) and Costa (2001). These studies typically estimate negative values for both β and δ relative to an initial base year. This implies that the measured increase in the cost of living over time overstates the true increase in the cost of living. Costa (2001) and Logan (2009) show that the magnitude of the bias depends on how the analysis accounts for demographics, especially household size, and that the size of the bias might vary over time. In particular, Costa argues that times when product variety expands rapidly coincide with larger bias in the CPI. Since real income growth is computed as nominal income growth less the growth rate of prices, when price inflation is overstated, real growth is understated. Costa's claim is consistent with the interpretation that more rapid expansion of product varieties leads to larger understatement of real income growth.

Real economic growth has been understated in New Zealand by around 1% annually (Gibson and Scobie, 2010) and in Australia, where bias is highest in single adult households (Barrett and Brzozowski, 2010). The collapse of the Soviet Union preceded a large economic downturn in Russia, but CPI bias led to this decline being overstated (Gibson et al., 2008).[5] Although these studies usually show the CPI to overstate increases in the cost of living, the opposite can be true, as research on Norway indicates (Larsen, 2007). Nakamura et al. (2014) argue that shifting Engel curves for Chinese households suggest official inflation and GDP growth rates are too smooth in China. Beatty and Larsen (2005) also consider the important impact of housing, in this case housing prices, and incorporate semiparametric techniques.

Others have used similar techniques to measure differences in the cost of living, and hence in real income, across space. Coondoo et al. (2011) compute price indices for fifteen Indian states using Engel curves, while Gong and Meng (2008) reevaluate the evolution of interregion inequality in China using similar methods. Almas (2012) argues that standard purchasing power parity adjustments used in comparing incomes across countries are inconsistent with evidence on food shares. An alternative correction for price differences based on Engel curves suggests much larger international dispersion of income than PPP numbers indicate.

Our work is closely related to two other papers. First, Hamilton (2001a) estimates

[5] See also de Carvalho Filho and Chamon (2012) on Brazil and Mexico during transition periods.

different inflation rates across demographic groups. Hamilton shows that during the 1970s and 1980s, the food-at-home share for black households fell faster than for white households, and by more than could be accounted for by growth in measured incomes. Hamilton interprets this as evidence that the true prices faced by blacks increased less quickly than prices faced by whites over this period. The magnitude of this difference is around 0.6 to 1% per year. Second, Brzozowski (2006) studies whether the cost of living for Canadian seniors evolves similarly to that for other households in Canada. He finds that the CPI overstated increases in the cost of living for seniors in the 1970s and 1980s, but that it has been more accurate in the 1990s. Like Hamilton (2001a) and Brzozowski (2006), we are estimating a difference in the degree of Engel curve drift across two groups.

3. Data

3.1. Consumer Expenditure Survey

Our estimates of CPI bias for the elderly use household data from the Consumer Expenditure Survey (CEX). The Bureau of Labor Statistics uses the CEX to calculate product weights for the Consumer Price Index. We use the quarterly interview survey that gathers data on household expenditure, income and demographic characteristics.[6] The interview survey is a rotating panel in which households (or Consumer Units, as the survey describes them) are surveyed for five quarters, though only four quarters ask about spending. The sample contains about seven thousand households in each quarter. Each quarter, one fifth of the sample drops out, to be replaced by an incoming cohort.

The data have a panel structure, but we mostly ignore the longitudinal dimension of the data and focus on between estimators. The main rationale for this approach is the concern that a fixed-effects estimator will be substantially influenced by measurement error in the expenditure data. We present one set of fixed effects estimates in the next section, but note that the overall CPI biases implied by these regressions are not as plausible as our other results. While measurement error is presumably present in the time-aggregated data, it may not be as severe, and we can instrument for total expenditures with income (which is recorded annually, not quarterly) to try to correct for the bias induced by the mismeasurement. In addition, there is some attrition, where not all households complete five rounds of the survey. Our main results are little changed if we restrict attention to households for which we have all waves of the expenditure survey.

[6] The diary survey, which has a separate sample, has households record every purchase they make over two-week periods, and does a better job of capturing small purchases.

Throughout the period examined (1988-2012), the budget share devoted to food has generally been greater for those over the age of 62 than those under (see Figure 1), and has been declining. The food Engel curve indicates food shares are lower at higher total expenditures for a household, so falling food shares could be explained by rising overall spending. However, measured real expenditures at the household level have not been generally increasing over this period. (See Table 1.) A few exceptions include the late 1990s, when the stock market and liquid wealth rose sharply. As others have shown, and as we show in the next section, the declining food share is only partially accounted for by measured changes in income. The remainder of the decline in the food share could be accounted for by CPI bias that masks an underlying increase in total household spending.

It is important to consider potential measurement errors in the CEX. Individual data excludes expenditures that are not out of pocket. Recall interviews tend to underestimate consumption, and in 1998 the CEX survey changed from monthly to weekly food spending, helping to reduce underestimation. Battistin and Padula (2010) demonstrate that the quality of data in the interview survey, particularly for small and infrequently purchased items, has declined over time.[7] Additionally, sample-gathering methods were changed in the final quarter of 1995, causing some families to not have complete annualized data for those years, reducing the sample size available. See Carroll et al. (2015) for more information about the CEX and household expenditure surveys generally.

One approach to dealing with noisy data is to exclude obviously problematic observations. Consistent with other studies, we trim out households with extreme food spending – less than 0.2% of total expenditure, or more than 80%. Our results are not particularly sensitive to these exclusions.

3.2. Consumer Prices

We use consumer price indices at the census region level (Northeast, South, Midwest, and West). We use the overall consumer price index for all urban consumers (CPI-U) to deflate nominal expenditures. We use the Food and Beverages subindex as the price of food and the CPI excluding food as the price of nonfood items to measure the relative price of food to nonfood. (Note that the CPI-W – the CPI for urban workers – is used for indexing social security payments. Note also that our conclusions about the relative difference in inflation rates does not depend on what deflator we use in constructing our

[7] Battistin and Padula (2010) show how to combine information from the diary survey with the interview survey to obtain more reliable estimates of consumption, even though the individuals in each survey are different.

measure of real expenditures.) The Bureau of Labor Statistics also produces price indices at the metropolitan area level, but not all households live in a large enough metropolitan area to be covered by these indices.

3.3. House Prices

We follow up on the possibility that the Engel curve drift for the elderly is the result of wealth movements. We use state-level house price data from the Federal Housing Finance Administration to evaluate whether our results reflect changes in housing wealth. We use both Purchase Only and All Transactions indices, where the All Transactions indices draw on both purchase prices and appraisals. These are repeat sales indices, but only refer to transactions where a mortgage was securitized by Freddie Mac or Fannie Mae.

4. Empirical Results

We use the Consumer Expenditure data to estimate Engel curves and infer CPI measurement error. Table 1 presents some basic summary statistics for our sample for 1990, 2000, and 2010. The food share overall is relatively stable across these three periods, but this masks compositional changes in the data. Among elderly and nonelderly households alike, there is a general tendency for the food share to fall. However, the share of elderly households, who have a higher share devoted to food, is rising over time, so the average food share across all households is little changed from 1990 to 2010, just over 13%.

We estimate the bias of the CPI for the elderly relative to the nonelderly using data from different households (i), in different census regions (j) at different time periods (t). We estimate the following regression equation

$$\omega_{it}^{food} = \alpha + \beta(\log Y_{it} - \log P_{jt}) + \delta_t + \delta_t^{elderly} D_{it}^{elderly} + \gamma x_{it} + \epsilon_{it} \tag{1}$$

where ω is a measure of the importance of food in the household's budget. This could be the food-at-home share, the log food-at-home share, the food share, or the log food share. The key explanatory variables are the log of real total expenditures – $\log Y_{it} - \log P_{jt}$ – and year effects that apply to the entire sample (δ_t) or to only the elderly households ($\delta_t^{elderly}$). Additional covariates include household age composition variables (such as the number of members of the household under two years old), urban status, census region dummies, and the relative price of food (which vary at the census region level). We also include dummies for the age of the household head in a set of four year bins.

This allows for a life-cycle profile of food spending (Fernandez-Villaverde and Krueger, 2007). Throughout, we use heteroskedasticity-robust variance estimates.

4.1. Main Results

Table 2 presents our main results, with Engel curves estimated using the share of expenditures on food at home, the overall food share, including food outside the home, and each of these outcomes in logs. We include a set of dummy variables for household head's age, aggregated into four-year bins, and these coefficients are presented in Figure 3.

Using the regressions with the food share as the outcome, the implied bias in the CPI is to overstate the annual rate of increase in the cost of living from 1988 to 2012 for nonelderly households by 0.55% on average. For elderly households, the CPI bias is 0.98% per year. These numbers are from the model with the overall food share as the outcome variable. Other columns from Table 2 imply broadly similar biases, with a consistent pattern that the bias is larger for the elderly.

The faster downward drift of the food Engel curve for the elderly is illustrated in Figure 4, which provides the coefficients on year dummy variables interacted with the elderly dummy. These coefficients are key inputs in calculating the cumulative deviation of the CPI from the true cost of living. The coefficients are initially small but grow larger since they show the cumulative bias in the CPI since 1988. The Engel curve for the food share has drifted down by around 0.01 more for the elderly over this period. A fall in the food share of 0.01 is consistent with total expenditure increasing by about 12% (so that log expenditure increases about 0.12, delivering a $0.12 * 0.083 \approx 0.01$ decrease in the food share). A 12% increase in income over the 24 year period corresponds to unmeasured income gains of 0.4% to 0.5% per year.

The results here point to the conclusion that the cost of living has risen more slowly since 1988 for the elderly than for the nonelderly, in contrast to the received wisdom. While studies that focus on the inappropriate weights problem (that the CPI weights are different from the weights for a typical elderly household) estimate the cost of living to rise about 0.3% per year faster for the elderly, we find that the elderly experience a cost of living that rises about 0.4% to 0.5% more slowly than other households. Since the CPI bias is how much price increases are overstated, it is also how much income gains are understated. Therefore, we conclude that unmeasured income gains have been larger for the elderly than the nonelderly.

The overall estimated bias is smaller than what Lebow and Rudd (2003) report. The bias is larger if we look from 1988 to 2005. From 1988 to 2005, the CPI bias for nonelderly households is estimated to be 1.57%, instead of 0.37%. From 2005 to 2012, the overall bias for nonelderly households is -2.51% per year. That is, the rate of increase in the CPI understates the true rate of increase in the cost of living since 2005. This implies that the magnitude of the Great Recession is larger than one might otherwise think since faster price increases imply larger real income declines for given nominal income. One possible explanation for this finding is shelter. Evaluating the cost of shelter for the CPI has been difficult, particularly due to owner-occupied housing.[8]

4.2. Alternative Estimators

Table 3 presents instrumental variables estimates for the food Engel curves in equation 1. We treat the total expenditure variable as endogenous, primarily due to concerns about measurement error. We use the log of income after tax as an instrument for the log of total expenditures. The estimated coefficients are broadly similar to the earlier estimates, with food shares being a little more elastic with respect to total expenditures. The pattern of finding positive CPI bias that is smaller for the nonelderly than the elderly is present in these estimates too. The magnitude of the difference between the elderly and nonelderly is very similar to before.

Hausman et al. (1995) present alternative IV estimates, using a household's total expenditure from another quarter as an instrument for current quarter expenditure. They report larger slopes in their IV estimates than in the least squares estimates. When we apply the same methods, we find IV estimates of the semi-elasticity of food expenditure with respect to total expenditure that are a little smaller than the least squares results. While there is some effect on the slope coefficients, the estimated CPI bias is little affected in these regressions.

Table 4 provides fixed effects estimates of the Engel curves. These estimates feature similar responses of the food share to expenditure, but result in very different estimates for the year dummy variables. The ultimate impact is to magnify substantially the estimated CPI bias, from around 0.5% per year to 3% to 8% per year, depending on the equation. These estimates are well outside the plausible range of bias in the CPI established in prior studies, a possible consequence of the fixed-effects estimator accentuating the noise-to-signal ratio in the relationship between food spending and total spending and the collinearity between year dummies and the implicit household dummies that are included in the fixed-effects estimator. As a result, we do not put much weight on these numbers.

[8] Further research might investigate the role of the house price cycle in driving the measured CPI bias we find here.

Hausman et al. (1995) argue that Engel curves should contain higher-order terms in the log expenditure variable on the right-hand side. Banks et al. (1997) maintain that this is not necessary for food, but we have estimated our Engel curves allowing for a quadratic of log expenditure to check the robustness of our conclusions. We can estimate the following specification

$$\begin{aligned}\omega_{it}^{food} &= \alpha + \beta_1(\log Y_{it} - \log P_t + \nu_t + \nu_t^{elderly} D_{it}^{elderly}) \\ &+ \beta_2(\log Y_{it} - \log P_t + \nu_t + \nu_t^{elderly} D_{it}^{elderly})^2 \\ &+ \gamma x_{it} + \epsilon_{it} \qquad (2)\end{aligned}$$

where ν_t is equivalent to δ_t/β from our earlier estimations, and x is a vector of covariates such as household demographics or the relative price of food. A version of this equation with more structure has the time effects be generated by deterministic trends. Note that the interpretation of the ν terms is that they correct measured real income for measurement error in the deflator. Therefore, they are added to the measured real income before the quadratic function of real income is evaluated. We estimate this equation by nonlinear least squares.

Accounting for this nonlinearity in the Engel curve does not affect our overall conclusion regarding the rate of change in the cost of living for the elderly and nonelderly. When using the overall food share as our outcome variable, these estimates indicate an annual upward bias in the CPI of 0.42% for nonelderly households, and 1.39% for elderly households. This difference is larger than in our prior estimates, though it has the same sign.

4.3. Alternative Definitions of Total Expenditure

In light of the concern that spending on shelter is poorly measured, we reestimate our Engel curves using total expenditure excluding shelter as the main right-hand side variable. Our primary result, that the cost of living has risen less quickly for the elderly, remains. Quantitatively, the difference in the rate of inflation for the elderly and nonelderly is slightly larger when we estimate having first excluded shelter from total expenditure.

The Engel Curve uses total expenditure both as an explanatory variable and as the denominator when calculating food shares. The CEX measure of total expenditures includes some spending on durables. The logic of the Engel curve is based on current consumption, so we consider our own versions of total spending that omit various expenditure categories that might reasonably be classified as durables. For example, health, education, automobile purchases and electronics. These omissions do not greatly alter the estimated relative CPI bias for elderly households.

4.4. Alternative Definitions of Elderly

As our baseline we define a household to be elderly if the household head is 62 or older. This is the age threshold used for defining elderly households in the CPI-E (Stewart, 2008). We reestimate our results using alternative age cutoffs for marking a household as elderly, considering 60, 65, and 70 as well 62. See Figure 4.[9] The difference in estimated CPI bias for the elderly relative to nonelderly is larger when we use 60 as the age threshold. When we use 65 or 70, the estimated bias for the elderly is closer to the overall estimated bias, though still larger. When the threshold age is 70, the difference between the bias for the elderly is not statistically significantly different from the nonelderly bias, though it continues to be statistically significantly different from the estimates in Hobijn and Lagakos (2003), for example.[10]

As a further alternative, we use the Consumer Expenditure Survey variable indicating the number of household members older than 64. We either use this directly or first divide by the household size to get a fraction of the household that is elderly. These variables are strongly correlated with the elderly dummies we use as our baseline definition of whether a household is elderly. A regression of the number of people in the household over 64 on the dummy for whether the household head is 62 or over yields a coefficient of 1.1, and the correlation between these variables is about 0.8. Results from these regressions are shown in table A.3. The estimated relative bias of the CPI for the elderly is still positive in all cases, but is smaller than in our earlier results even after accounting for the different scales of these variables. When we use the fraction of the household older than 64, the standard errors are large enough that the estimated biases are not statistically significantly different from zero, unlike our other results.

4.5. Housing Wealth and Consumption

In a robustness check, we add house prices to our regressions. We estimate a gap between the official CPI and the overall cost of living that resembles the national house price cycle

[9]Table A.1 presents the bias estimates using a consistent nonelderly comparison group – those where the reference person is under 60. Table A.2 uses a changing comparison group, so that every household is included in each regression, either as elderly or as nonelderly. Table A.3 uses the CEX variable indicating how many members of the household are older than 64 as the basis for determining how elderly a household is.

[10]Another possible interpretation of this pattern is that the estimated nonelderly bias when the cutoff is 70 incorporates both the lower overall bias and some contribution from a higher CPI bias for the young elderly (those in their sixties).

over the last twenty years. This fact suggests that the overall drift in the Engel curve we estimate could reflect a wealth effect, which Case et al. (2005) and Carroll et al. (2011) suggest is much stronger for housing wealth than for financial wealth, and is presumably larger for the elderly than the nonelderly since the elderly tend to have longer positions in the housing market.

In the present paper, we are concerned primarily with the differential drift of the Engel curve for elderly households compared with nonelderly. If there are different wealth effects for these groups (based on different homeownership rates, for example), the faster drift in the Engel curve for the elderly could be due to faster wealth accumulation. Mian et al. (2013) estimate wealth effects due to housing wealth destruction in the Great Recession. Using information from credit card purchases at the county level, they find that grocery purchases (the closest concept to food they report) are relatively insensitive to wealth, while total purchases are much more sensitive. A negative wealth shock would lower overall spending significantly and increase the food share. However, based on estimates in Mian et al. (2013), a household with typical levels of total expenditure and wealth decline over the 2006-2009 period would move along the Engel curve traced out by our estimates, rather than deviating from the curve.

We add state-level house price data from the Federal Housing Finance Administration to our regressions. We interact the house price series (either Purchase Only or All Transactions indices) with the elderly household head dummy to allow for differential housing wealth effects by age of head (Campbell and Cocco, 2007). However, the expanded regressions do not show very different overall CPI bias nor very different relative bias of the CPI for the elderly than do our earlier regressions.

5. Social Security Indexation

One policy motivation for studying the changing cost of living for the elderly is that social security payments are indexed to the Consumer Price Index. The Social Security Administration issues an annual report about the current and expected future status of the trust funds that support the program (Board of Trustees, Federal Old-age and Survivors Insurance and Federal Disability Insurance Trust Funds, 2014). The forecast trajectories of the funds' receipts and expenses depend on a large number of anticipated demographic and economic factors, including the CPI.

We make some rough approximations to forecast an alternative scenario in which social security cost of living adjustments (COLAs) are slightly lower than the anticipated rate of increase in the CPI. Whereas the 2014 report of the social security Board of Trustees forecasts the trust funds will run out of money in 2033, our calculations suggest the funds would be solvent for about two more years if the COLA is 0.3 percentage points per year lower than the forecast rate of increase in the relevant CPI. (This is broadly consistent with the findings of Hobijn and Lagakos (2003) who find the fund would be exhausted two years earlier, based on a COLA that is 0.22 percentage points per year higher than the CPI inflation rate.) If the COLA is reduced by 0.9% per year, roughly the full amount we estimate the CPI inflation rate to have overstated the cost of living increases for the elderly, the funds would be solvent for four more years than currently projected.

The changes to the COLA we have considered do not much affect the sustainability of the social security trust fund. The social security system faces substantial increases in the benefits it pays out, but these benefit increases are driven mostly by demographics and also by economy-wide wage gains, since the initial benefit payment for a retiree is based on the person's earnings history.

In addition, a lower COLA amounts to a reduction in the expected benefit for a social security recipient. If a change to the cost of living adjustment is not intended as an overall benefit reduction, the initial benefit level could increase to offset the slower growth of benefits. Our calculations suggest that a COLA 0.3 percentage points lower together with a 1.5% increase in the starting point for benefits would lead to the social security trust fund being exhausted at the same time as current projections imply.

6. Conclusion

A common concern is that the elderly face a higher rate of inflation than others, particularly because of the high weight on medical care in their budgets. Prior research has estimated the inflation rate for the elderly by constructing price indices with elderly-specific expenditure weights. This assumes that other sources of measurement error in the CPI are equally important for the elderly and nonelderly alike. We relax this assumption, and construct an indirect measure of the overall rate of change in the cost of living for the elderly. Specifically, we measure the rate of increase in the cost of living based on drifts in food Engel curves estimated from household expenditure survey data.

Since the late 1980s, elderly households in particular have exhibited a sustained decline in the share of total expenditure devoted to food. This decline in food expenditure as a share of output is larger than can be explained by a movement along the food Engel curve, and is larger than the unexplained decline in food expenditures among nonelderly households. We interpret this as evidence that the rate of increase of the cost of living has been slower for elderly households than for nonelderly households by about 0.3%

to 0.4% per year, with an overall upward bias in the CPI inflation rate of around 0.8% to 1% per year for the elderly. This suggests that changes in social security indexation that compensate the elderly for a faster rate of inflation could be inappropriate.

Additionally, our findings suggest that the CPI has understated the rate of increase of the cost of living since the end of the housing boom in the United States. This implies a more severe decline in incomes during the Great Recession than has otherwise been perceived. We anticipate that future research will consider the role of the house price cycle in accounting for the CPI biases we document.

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Tables and Figures

Figure 1: Food at home as share of total expenditures over time

Figure 2: Food Engel curves have drifted down over time

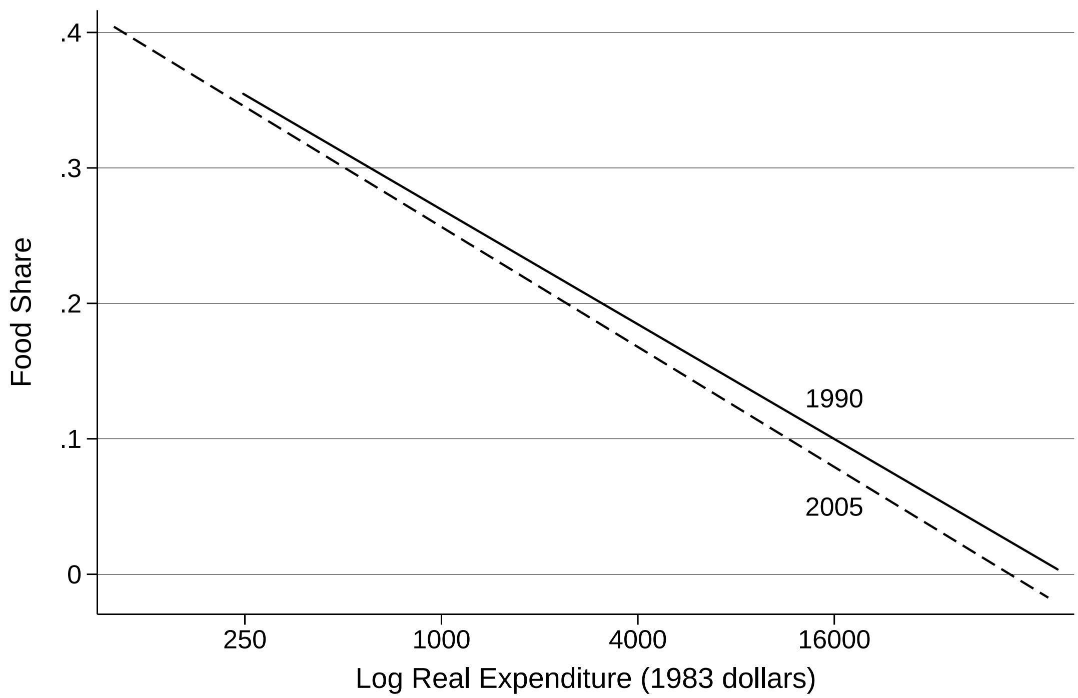
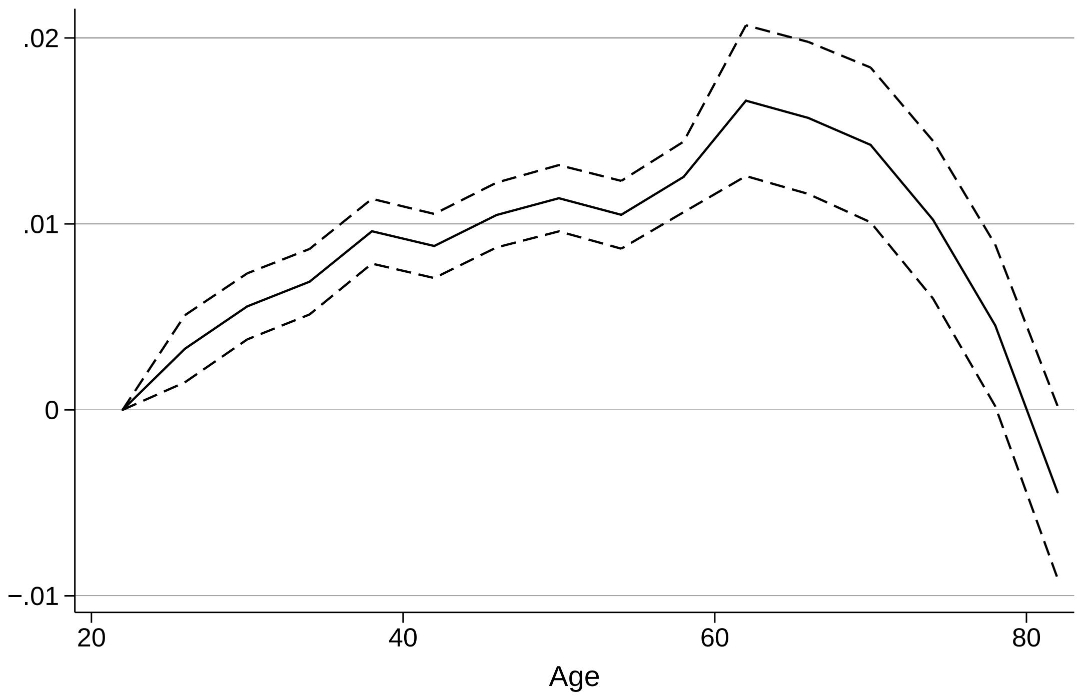
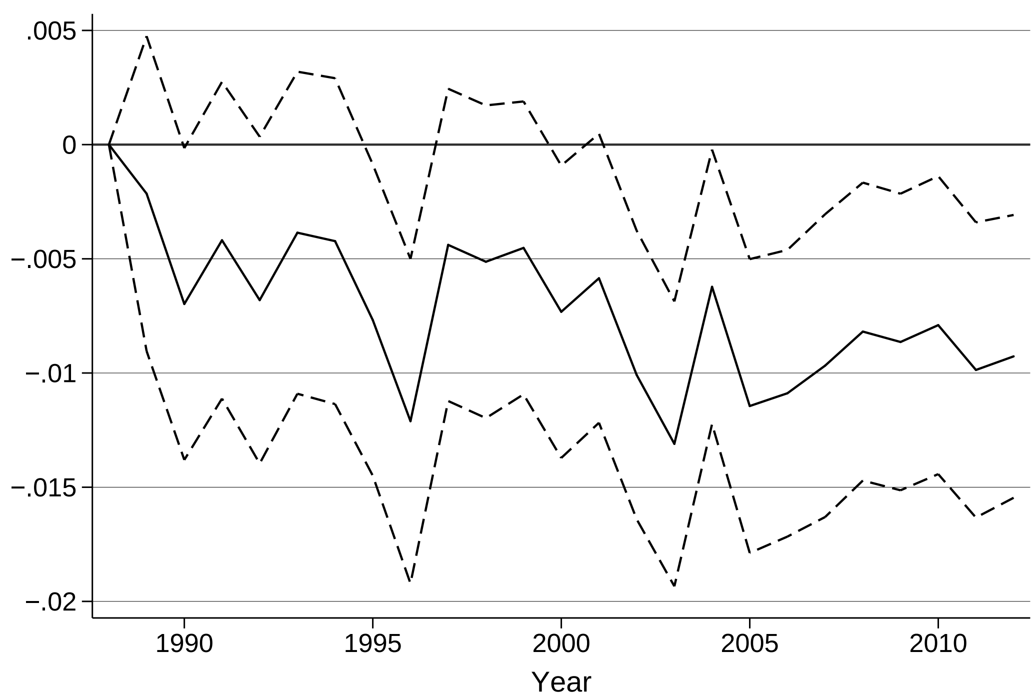


Figure 3: Age coefficients in Engel curve



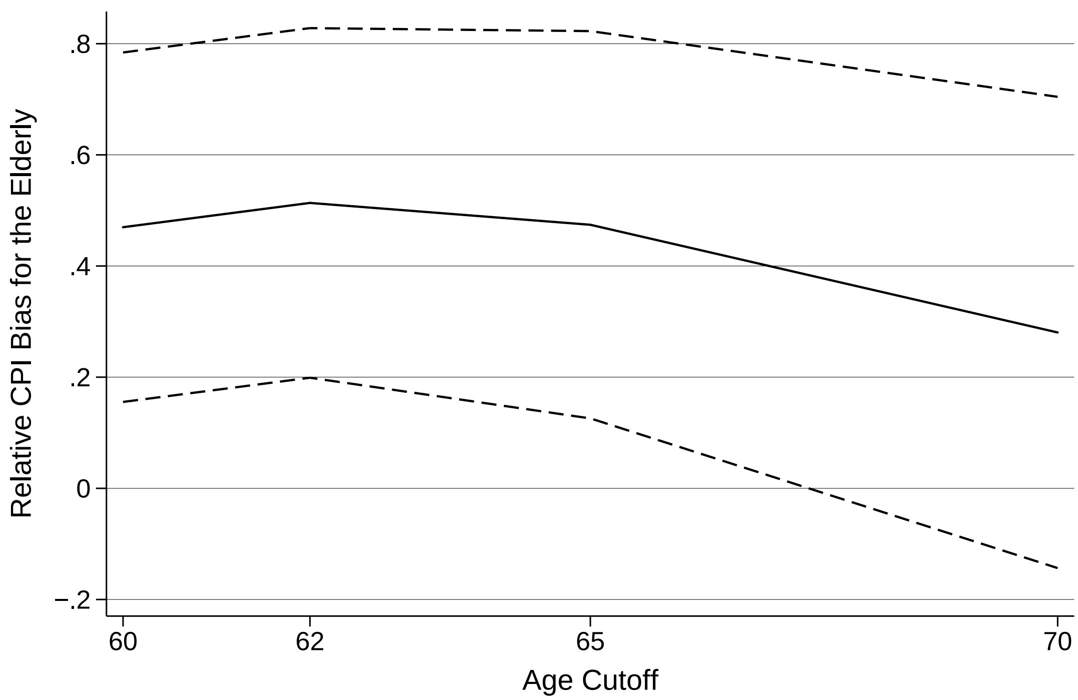
Notes: this graph plots coefficients on age dummies in a variant of the regression in column (3) of Table 2, along with two standard error bands. The equation is estimated with elderly by year interactions, and the regression is estimated with 1999 being the omitted year for the interaction, so the coefficients in the graph are interpreted as the age profile of food share in the 1999, approximately the middle year of the estimation sample.

Figure 4: Food Engel curves have drifted down faster for elderly households



Notes: this figure shows the coefficients on the interaction between year and elderly dummies in column (3) of Table 2, along with two standard error bands. It shows how much more the Engel curve has shifted for elderly households than for nonelderly households.

Figure 5: Relative CPI Bias for the Elderly, for Different Age Cutoffs



Notes: this figure shows the excess bias of the CPI for the elderly relative to the nonelderly for different definitions of elderly. In each case, the nonelderly group contains households where the head is younger than 60. Elderly households are those whose head is at or above the age cutoff indicated on the horizontal axis. Any intermediate households are omitted. The bias estimates reported here are derived from estimating equation (1) with food share as the outcome variable.

Table 1: Summary Statistics

	1990	2000	2010	Total
Food-at-home share	0.132	0.139	0.132	0.135
	(0.0661)	(0.0886)	(0.0831)	(0.0818)
Food share	0.178	0.180	0.182	0.180
	(0.0685)	(0.0930)	(0.0930)	(0.0879)
Total Expenditure (1983 dollars)	5243.7	5169.8	5297.0	5234.2
	(3151.8)	(4162.6)	(4314.0)	(4009.7)
Household size	2.563	2.526	2.466	2.512
	(1.194)	(1.480)	(1.490)	(1.423)
Age of Head	45.25	46.64	48.09	46.85
	(13.96)	(17.56)	(17.57)	(16.82)
Elderly (head 62 or older)	0.142	0.217	0.230	0.204
	(0.349)	(0.412)	(0.421)	(0.403)

Table 2: Engel Curve Estimates

	(1)	(2)	(3)	(4)
Log Real Expenditure (1983 dollars)	-0.088	-0.679	-0.083	-0.484
	(0.000)	(0.002)	(0.000)	(0.002)
Relative price of food (log)	0.193	1.455	0.233	1.329
	(0.013)	(0.087)	(0.014)	(0.080)
Males age 16 and over	0.023	0.208	0.025	0.164
	(0.000)	(0.002)	(0.000)	(0.001)
Females age 16 and over	0.022	0.193	0.015	0.098
	(0.000)	(0.002)	(0.000)	(0.002)
Males age 2 through 15	0.022	0.170	0.018	0.106
	(0.000)	(0.002)	(0.000)	(0.001)
Females age 2 through 15	0.021	0.159	0.017	0.098
	(0.000)	(0.002)	(0.000)	(0.001)
Members under age 2	0.017	0.129	0.005	0.017
	(0.001)	(0.004)	(0.001)	(0.003)
Urban	0.001	0.006	0.005	0.033
	(0.001)	(0.004)	(0.001)	(0.004)
Age effects	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes
R-squared	0.482	0.530	0.376	0.397
N	206443	206443	206443	206443
Nonelderly Bias	0.737	0.595	0.550	0.505
	(0.052)	(0.046)	(0.063)	(0.057)
Elderly Bias	1.075	0.864	0.975	0.894
	(0.114)	(0.086)	(0.136)	(0.111)
Relative Bias	0.338	0.269	0.424	0.389
	(0.124)	(0.096)	(0.148)	(0.123)

Notes: columns have as the outcome variable food-at-home share, log food-at-home share, overall food share, and log overall food share respectively. All regressions contain year dummies and year dummies interacted with the elderly indicator.

Table 3: Engel Curve Estimates (IV)

	(1)	(2)	(3)	(4)
Log Real Expenditure (1983 dollars)	-0.097	-0.709	-0.089	-0.479
	(0.001)	(0.003)	(0.001)	(0.003)
Relative price of food (log)	0.162	1.219	0.199	1.178
	(0.014)	(0.098)	(0.016)	(0.091)
Males age 16 and over	0.026	0.215	0.026	0.162
	(0.000)	(0.002)	(0.000)	(0.002)
Females age 16 and over	0.023	0.195	0.016	0.096
	(0.000)	(0.002)	(0.000)	(0.002)
Males age 2 through 15	0.022	0.169	0.018	0.106
	(0.000)	(0.002)	(0.000)	(0.002)
Females age 2 through 15	0.022	0.161	0.018	0.100
	(0.000)	(0.002)	(0.000)	(0.002)
Members under age 2	0.017	0.127	0.005	0.016
	(0.001)	(0.004)	(0.001)	(0.004)
Urban	0.004	0.013	0.008	0.040
	(0.001)	(0.005)	(0.001)	(0.004)
Age effects	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes
R-squared	0.476	0.529	0.371	0.392
N	165293	165293	165293	165293
Nonelderly Bias	0.647	0.563	0.451	0.458
	(0.052)	(0.050)	(0.064)	(0.065)
Elderly Bias	0.879	0.782	0.820	0.898
	(0.113)	(0.092)	(0.139)	(0.125)
Relative Bias	0.231	0.219	0.369	0.439
	(0.122)	(0.102)	(0.151)	(0.138)

Notes: columns have as the outcome variable food-at-home share, log food-at-home share, overall food share, and log overall food share respectively. All regressions contain year dummies and year dummies interacted with the elderly indicator. The log of total expenditure is treated as endogenous, with log income after tax used as the instrument.

Table 4: Engel Curve Estimates (Fixed Effects)

	(1)	(2)	(3)	(4)
Log Real Expenditure (1983 dollars)	-0.077	-0.761	-0.083	-0.643
	(0.000)	(0.002)	(0.000)	(0.002)
Relative price of food (log)	0.119	1.207	0.243	1.526
	(0.041)	(0.282)	(0.047)	(0.256)
Males age 16 and over	0.018	0.188	0.020	0.160
	(0.000)	(0.003)	(0.001)	(0.003)
Females age 16 and over	0.016	0.155	0.012	0.089
	(0.000)	(0.003)	(0.001)	(0.003)
Males age 2 through 15	0.022	0.174	0.018	0.109
	(0.001)	(0.004)	(0.001)	(0.003)
Females age 2 through 15	0.020	0.154	0.016	0.094
	(0.001)	(0.004)	(0.001)	(0.003)
Members under age 2	0.014	0.112	0.007	0.040
	(0.001)	(0.005)	(0.001)	(0.004)
Urban	-0.002	-0.020	-0.001	-0.018
	(0.003)	(0.025)	(0.004)	(0.023)
Age effects	Yes	Yes	Yes	Yes
R-squared	0.766	0.796	0.721	0.741
N	651883	651883	651883	651883
Nonelderly Bias	4.23	2.17	6.83	4.49
	(0.285)	(0.199)	(0.314)	(0.224)
Elderly Bias	4.66	2.16	6.96	4.18
	(0.330)	(0.225)	(0.361)	(0.255)
Relative Bias	0.43	-0.01	0.13	-0.31
	(0.222)	(0.154)	(0.245)	(0.175)

Notes: columns have as the outcome variable food-at-home share, log food-at-home share, overall food share, and log overall food share respectively. All regressions contain year dummies and year dummies interacted with the elderly indicator.

A Additional Tables

This appendix provides additional results for the relative CPI bias for differing definitions of elderly households. Some of the information in these tables is also in figure 5.

Table A.1: CPI Bias Estimates, for Different Definitions of Elderly

	(1)	(2)	(3)	(4)
Elderly: Age $\geq$ 60				
Nonelderly Bias	0.769	0.607	0.561	0.511
	(0.056)	(0.050)	(0.068)	(0.062)
Elderly Bias	1.144	0.910	1.031	0.942
	(0.124)	(0.093)	(0.148)	(0.121)
Relative Bias	0.375	0.303	0.470	0.431
	(0.134)	(0.104)	(0.160)	(0.134)
Elderly: Age $\geq$ 62				
Nonelderly Bias	0.731	0.572	0.511	0.463
	(0.057)	(0.051)	(0.069)	(0.063)
Elderly Bias	1.141	0.907	1.025	0.934
	(0.124)	(0.093)	(0.148)	(0.120)
Relative Bias	0.410	0.335	0.514	0.471
	(0.134)	(0.104)	(0.160)	(0.134)
Elderly: Age $\geq$ 65				
Nonelderly Bias	0.726	0.569	0.502	0.456
	(0.057)	(0.051)	(0.069)	(0.063)
Elderly Bias	1.088	0.818	0.976	0.866
	(0.140)	(0.104)	(0.167)	(0.134)
Relative Bias	0.362	0.249	0.474	0.411
	(0.149)	(0.115)	(0.178)	(0.146)
Elderly: Age $\geq$ 70				
Nonelderly Bias	0.729	0.573	0.503	0.458
	(0.057)	(0.051)	(0.069)	(0.063)
Elderly Bias	1.015	0.801	0.783	0.756
	(0.177)	(0.129)	(0.207)	(0.167)
Relative Bias	0.287	0.228	0.281	0.298
	(0.184)	(0.138)	(0.216)	(0.177)

Nonelderly is always younger than 60.

Notes: columns have as the outcome variable food-at-home share, log food-at-home share, overall food share, and log overall food share respectively. All regressions are specified as in Table 2, but with the age cutoff for elderly households changing. Households whose head is considered too old to be nonelderly but too young to be elderly are omitted.

Table A.2: CPI Bias Estimates, for Different Definitions of Elderly
Alternative Approach

	(1)	(2)	(3)	(4)
Elderly: Age $\geq$ 60				
Nonelderly Bias	0.732	0.573	0.513	0.467
	(0.057)	(0.051)	(0.069)	(0.063)
Elderly Bias	1.211	0.977	1.115	1.022
	(0.115)	(0.087)	(0.137)	(0.113)
Relative Bias	0.480	0.404	0.603	0.555
	(0.126)	(0.099)	(0.151)	(0.127)
Elderly: Age $\geq$ 62				
Nonelderly Bias	0.769	0.607	0.561	0.511
	(0.056)	(0.050)	(0.068)	(0.062)
Elderly Bias	1.144	0.910	1.031	0.942
	(0.124)	(0.093)	(0.148)	(0.121)
Relative Bias	0.375	0.303	0.470	0.431
	(0.134)	(0.104)	(0.160)	(0.134)
Elderly: Age $\geq$ 65				
Nonelderly Bias	0.797	0.641	0.591	0.546
	(0.055)	(0.049)	(0.067)	(0.061)
Elderly Bias	1.101	0.827	0.999	0.888
	(0.140)	(0.105)	(0.168)	(0.135)
Relative Bias	0.304	0.186	0.407	0.342
	(0.149)	(0.114)	(0.178)	(0.146)
Elderly: Age $\geq$ 70				
Nonelderly Bias	0.826	0.656	0.642	0.584
	(0.054)	(0.047)	(0.065)	(0.059)
Elderly Bias	1.032	0.814	0.818	0.787
	(0.178)	(0.130)	(0.210)	(0.169)
Relative Bias	0.206	0.158	0.176	0.203
	(0.184)	(0.137)	(0.218)	(0.178)

Notes: columns have as the outcome variable food-at-home share, log food-at-home share, overall food share, and log overall food share respectively. All regressions are specified as in Table 2, but with the age cutoff for elderly households changing.

Table A.3: Relative CPI Bias Estimates using Number of Household Members over 64

	(1)	(2)	(3)	(4)
Elderly: number of persons older than 64 in household				
Nonelderly Bias	0.790	0.629	0.606	0.558
	(0.056)	(0.049)	(0.068)	(0.061)
Elderly Bias	1.030	0.810	0.838	0.756
	(0.088)	(0.067)	(0.106)	(0.088)
Relative Bias	0.241	0.181	0.233	0.198
	(0.091)	(0.071)	(0.109)	(0.093)
Elderly: fraction of household older than 64				
Nonelderly Bias	0.818	0.657	0.618	0.567
	(0.056)	(0.049)	(0.067)	(0.061)
Elderly Bias	1.016	0.763	0.888	0.802
	(0.158)	(0.118)	(0.188)	(0.151)
Relative Bias	0.198	0.106	0.270	0.236
	(0.169)	(0.130)	(0.202)	(0.165)

Notes: columns have as the outcome variable food-at-home share, log food-at-home share, overall food share, and log overall food share respectively. All regressions are specified as in Table 2, but with the elderly household variable now replaced by the number of household members older than 64.