REPORT TO THE OFFICE OF MANAGEMENT AND BUDGET

Consumer Inflation Measures

June 16, 2021

Contents

(Note: Document errors have been corrected subsequent to publication that reflect the intent of the ITWG.)

EXECUTIVE SUMMARY

In 2019, the Office of Management and Budget (OMB) convened an Interagency Technical Working Group on Consumer Inflation Measures (hereafter 'ITWG') to evaluate the strengths, weaknesses, and best practices for the application of the primary consumer inflation measures produced by Federal statistical agencies. The ITWG was chartered to: (1) develop a Federal Register Notice (FRN) to solicit public comment on its planned activities, (2) develop a recommendation on the consumer inflation measure most appropriate for conducting annual adjustments to the Official Poverty Measure (OPM), (3) recommend whether OMB guidance on the use of the various inflation measures by Federal agencies is feasible, (4) prepare and submit a report containing recommendations on the remaining issues around appropriate use of existing inflation measures, and (5) provide a report describing the strengths and weaknesses of the methodologies used in the consumer inflation measures. This report incorporates all five ITWG responsibilities and the two following recommendations to OMB.

Recommendation 1: Official poverty measure

The ITWG developed cohort consumer price indexes for households at the lower end of the income distribution, in order to explore the inflation experience of a low-income subset of the population. The results of this research indicate low-income cohorts tend to have different budget shares than the overall urban population which, when applied to the data from 2004 to 2017, resulted in higher estimates of inflation for these cohorts. The ITWG recommends the Bureau of Labor Statistics (BLS) pursue development of a new consumer price index specifically designed to represent the inflation experience of low-income consumers, and that OMB use that new index to adjust the Official Poverty Measure. To that end, a formula measuring price change based on the current behavior of consumers is superior to one based on consumer behavior from several years ago. Therefore, an index that uses the Tornqvist (or a similar formula that averages spending from adjacent time periods) should be used in the construction of the low-income index. (See section 4.1.)

Recommendation 2: Need for OMB guidance

Evaluating a given price index's fitness for a particular purpose requires an understanding of the strengths and weaknesses of the various indexes available, and also a comprehensive understanding of the specific use under consideration. ITWG determined that any guidance OMB could disseminate on the fitness for use would be of little value to agencies, because guidance could only reasonably consider the measures themselves in isolation from any potential specific agency use. ITWG recommends the BLS provide additional resources to assist users on index choice. (See section 4.2.)

SECTION 1: BACKGROUND

In its role as coordinator of the Federal statistical system under the Paperwork Reduction Act, OMB is required to ensure the system's efficiency and effectiveness. A key way OMB fulfills this responsibility is by promulgating, maintaining, and overseeing Government-wide principles, policies, standards, and guidance concerning the development, presentation, and dissemination of Federal statistical products. OMB's Office of Statistical and Science Policy (SSP), within the Office of Information and Regulatory Affairs, relies on public comment, stakeholder input, and subject matter expertise to identify areas where existing OMB policies or guidance may be out of date, lacking clarity, or insufficient for efficient coordination of Federal statistics.

OMB convened an interagency technical working group (ITWG) to advise OMB on the strengths, weaknesses, and best practices for the application of various inflation measures produced by Federal statistical agencies. The members of the ITWG are subject matter experts in inflation measurement from across Federal government. Staff from seven different departments participated on the group. Members of the group do not represent their respective agency in an official agency head capacity; members were selected based solely on their technical expertise. The Bureau of Labor Statistics (BLS) chaired the group alongside a non-voting representative from OMB.

1.1 Charge to the ITWG

Specifically, OMB charged the ITWG with the following tasks:

- Develop and submit a draft **Federal Register Notice** (FRN) soliciting public comment on the strengths and weaknesses of the existing consumer inflation measures produced by the BLS and the Bureau of Economic Analysis (BEA) to the Chief Statistician of the U.S. to be reviewed and then issued by SSP;

- Deliver a final recommendation on the consumer inflation measure most appropriate for conducting annual adjustments to the **Official Poverty Measure** (OPM) that considers the public comments received from the FRN and provide it to the Chief Statistician of the U.S.;

- Deliver a final recommendation on whether OMB guidance on the use of the various inflation measures by Federal agencies is feasible;

- Prepare and submit a report containing recommendations on the **remaining issues** around appropriate use of existing inflation measures — including for adjusting Census Bureau historical figures — that takes into account the public comments received from the FRN; and

- Provide a report concerning the **strengths and weaknesses** of the methodologies used in the Federal Government's primary consumer inflation measures and make a recommendation on the feasibility for guidance from OMB on the appropriate use of the various indexes.

1.2 Using a price index to adjust for inflation

Inflation is commonly defined as a rise in the general level of prices, and deflation as a decline in the general level of prices.[1] Equivalently, inflation represents a decline in the purchasing power of money. As a general matter, adjusting statistics and other data for inflation better reflects consumers' actual experiences over time. There are many different ways in which inflation indexes attempt to capture this change in the level of prices. Specifically, the inflation statistics produced by BLS and BEA differ in their scope, weighting, formulas, underlying assumptions, and other factors consistent with their measurement objectives. The definition of a price index, as stated by the *Consumer Price Index Manual: Theory and Practice* is:

> A measure of the proportionate or percentage change in a set of prices over time. A consumer price index (CPI) measures changes in the prices of goods and services that households consume for personal use.[2]

As prices of different goods and services do not necessarily all change at the same time and by the same amount, a price index aggregates their movement. There are a variety of different consumer inflation measures currently produced by Federal statistical agencies which vary in how they address three fundamental questions concerning inflation measurement: (1) what population is the index designed to represent, (2) exactly what set of prices should be covered by the index, and (3) what is the most appropriate way to aggregate their movements?

The answers to these three basic questions usually turn on the primary underlying intended use of an index. Indexes have a variety of uses:

- As a compensation measure (e.g., how much is needed to adjust benefit amounts for Social Security beneficiaries);
- As an inflation adjustment in escalation clauses of private contracts;
- Inflation-indexed Treasury bonds;
- As an adjustment to marginal tax rate income brackets to keep the tax system inflation neutral;
- In estimating real values — as a deflator to convert current period nominal values to prior period values or an inflator to convert prior period values to current period values; and
- As an inflation yardstick for macroeconomic policy makers .

The BLS publishes five major aggregate index categories: 1) the CPI for all urban consumers (CPI-U), which is the flagship or headline index published by BLS; 2) the CPI for urban wage earners and clerical workers (CPI-W), which is the historical index dating back to 1912 and the index currently

[1] Collins Dictionary of Economics, 4th ed. © C. Pass, B. Lowes, L. Davies 2005.
[2] International Labour Office, et. al. Consumer Price Index Manual Theory and Practice, ILO/IMF/OECD/UNECE/Eurostat/The Word Bank, Geneva, Switzerland. 2004, p. 1.

used by the Social Security Administration (SSA) for calculating cost-of-living-adjustments to Social Security benefits; 3) a research index estimating the inflation experience of elderly consumers (R-CPI-E); 4) an index designed to capture consumer substitution across component consumption categories (Chained CPI-U), which is the index used since 2018 to inflation adjust federal tax brackets; and 5) a research series which approximates inflation retrospectively to 1978 using current CPI-U methods (R-CPI-U-RS). Other indexes are available upon request (e.g., an index adopting a fixed-base aggregation methodology (CPI-U-X1)). Additionally, BLS researchers have occasionally created additional research series, including indexes based on the spending behavior of low-income households.

The BEA features five different inflation measures on its website: 1) the GDP Price Index, 2) the GDP Deflator, 3) the Gross Domestic Purchases Price Index, 4) the Personal Consumption Expenditures Price Index (PCE-PI), and 5) the PCE index excluding food and energy. In addition, the BEA publishes regional price parities by state and metropolitan area (indexes that measure price levels across geography), and an experimental health care index that measures price change of various disease treatments.

1.3 The Official Poverty Measure

The current OPM uses a set of thresholds that are compared to annual pre-tax income to identify families in poverty for statistical purposes. There are different thresholds varying by the number of adults and children in a family and, for some family types, by the age of the family head. The thresholds were originally set at the cost of a minimum food diet (USDA's "economy food plan") times three to allow for expenditures on all other goods and services. The multiplier of three represented the after-tax monetary income of the average family in 1955 relative to the amount spent on food.[3]

As early as November 1965, SSA policymakers and analysts began to express concern about how to adjust the poverty thresholds for increases in the general standard of living. In 1968, the SSA tried to raise the poverty thresholds in real terms to reflect increases in the general standard of living. The Bureau of the Budget (the predecessor of OMB) prohibited the real increase in the poverty thresholds, but initiated an interagency Poverty Level Review Committee to re-evaluate the poverty thresholds. This Committee decided to adjust the thresholds only for price changes, and not for changes in the general standard of living. In 1969, the Committee decided the thresholds would be indexed by the Consumer Price Index instead of the per capita cost of the economy food plan, and that farm poverty thresholds would be set at 85 percent rather than 70 percent of corresponding nonfarm thresholds. This effectively made the annual adjustment a function of overall inflation, rather than food price inflation. In August 1969, the Bureau of the Budget designated the poverty thresholds with these revisions as the federal government's official statistical definition of poverty.

The official measure gained its status through the Bureau of the Budget's Circular A-46, issued in 1969. OMB, the successor agency to the Bureau of the Budget, issued Statistical Policy Directive 14 in 1978, reconfirming the measure as official and directing federal agencies to use it for statistical

[3] Fisher, Gordon, The Development and History of the Poverty Thresholds" Social Security Bulletin Vol 55, No. 4, Winter 1992.

purposes. (See Appendix A.1.) It describes the series as a classification of income applied to a set of poverty thresholds developed by the SSA, subsequently modified by a Federal Interagency Committee in 1969. The directive explicitly states the measure was not developed for administrative purposes, and allows for other measures of poverty to be developed, as long as those measures are distinguished from the official series.

Currently, the OPM thresholds are re-estimated annually by taking the 1978 values and adjusting them forward by an index of price change. They are not derived by a re-evaluation of the standards for minimum nutrition or subsistence, nor from direct observation of spending from household expenditure surveys. The index used for the inflation adjustment has varied over the history of the series:

- 1963 to 1968: December to December change in the per capita cost of the economy (or low cost) food plan, published by the USDA[4]
- 1969 to 1979: Annual change in the All-items Consumer Price Index, the index currently labeled the CPI-W, published by the BLS[5]
- 1980 to current: Change in the annual average Consumer Price Index for all urban consumers, labeled the CPI-U and published by BLS[6]

A simplified equation illustrating the calculation of the official poverty threshold (P) for a given year (y) can be expressed as:

$$P_y = P_b \left(\frac{I_y}{I_b} \right)$$

where I_y = an index of price change (currently the CPI-U) in year y. The ITWG is narrowly charged with identifying and evaluating the various different indexes of price change (I) that could be used for indexation between a base year (b), currently 1978, and current year (y), and recommending the index that is most appropriate for the purpose of estimating the current year (y) poverty thresholds (P).

For more than 40 years, the standards in OMB's Statistical Policy Directive 14 have provided a shared threshold for Federal statistical agencies to generate U.S. poverty statistics over time.

The OPM guidelines should not be confused with the poverty guidelines produced annually by the U.S. Department of Health and Human Services. While the poverty thresholds are used for calculating official poverty population statistics, the poverty guidelines are used for administrative purposes. Most commonly the poverty guidelines are used by a number of federal, state, local, and non-profit

[4] Fisher, Gordon, The Development and History of the Poverty Thresholds. Social Security Bulletin Vol 55, No. 4, Winter 1992.

[5] Poverty estimates in prior years were revised to reflect the 1969 adjustments. These included changes to the relative poverty thresholds for farm and non-farm households.

[6] In 1981, the poverty thresholds were adjusted to eliminate differences between the following groups: 1) farm and non-farm households and 2) families with a female householder, no husband present and all other families.

programs, such as Medicaid and the Supplemental Nutrition Assistance Program (SNAP), to determine income eligibility. The guidelines are based on the previous year's poverty thresholds, and updated for inflation using the CPI-U, based on statutory language in the Community Services Block Grant Act (42 U.S.C. §9902(2)). Because of this, changes to the poverty thresholds, including how they are updated for inflation over time, may affect eligibility for programs that use the poverty guidelines.

SECTION 2: ITWG ACTIVITIES

To meet the charges described in section 1, the ITWG conducted a literature review, solicited and reviewed public comment, and conducted original research on the inflation experience of low-income consumers.

2.1 Public comment

OMB published a Federal Register Notice (FRN) on May 7, 2019 seeking public comment on the differences among the primary consumer inflation measures produced by BLS and BEA and how those differences might influence the estimation of the Official Poverty Measure. The FRN received 57,127 comments from the public, the vast majority of which expressed opposition to a revision to the Official Poverty Measure on the basis of the potential impact to eligibility for various needs-based programs. We also received comments from several members of Congress and other elected officials representing state, Tribal, and local governments. These commenters expressed concern about possible reductions in federal services within their communities and opposed revising the OPM on those grounds. All public comments can be viewed at: https://www.regulations.gov/document/OMB-2019-0002-0001. (See Appendix A.2 for the full text of the FRN.)

The following specific objections were raised by several commenters:

- The Chained CPI-U does not represent the low-income population because:
    - Low-income consumers spend a larger proportion of their income on high-inflation expenditures, like energy and housing, and thus have different spending patterns than the urban population at large
    - Low-income consumers have limited opportunity to substitute across items
- Revising the OPM makes it less valuable as a long-standing and consistent statistical measure.
- The OPM already fails to keep up with living standards.
- The OPM has several flaws that should be prioritized over updating the method of inflation adjustment, including:
    - Geographic differences
    - Changes to the demographic composition of the workforce
    - Changes to employment-necessary expenses, such as internet access

- No changes should be made to the OPM without an analysis of potential program impacts.

Commenters supporting a revision to the OPM cited the likely overestimation of inflation by the CPI-U and CPI-W due to the failure to account for upper-level substitution bias, which occurs when component indexes for item groups and areas are aggregated to form the all-items measure. The BLS uses a fixed quantity weighted index for this purpose (with weights derived from the Consumer Expenditure Survey (CE), a survey of household expenditure patterns), and hence ignores substitutions of chicken for beef, apples for oranges, etc.[7]

Several commenters identified publications for the ITWG's literature review discussed in the upcoming section.

2.2 Literature review

BLS economists examined the inflation experience of the poor nearly 25 years ago. Recognizing the possibility that consumers at different ends of the income distribution might have different experiences of price change and that this could be relevant for adjustments of thresholds, Garner, Johnson, and Kokoski (1996) presented results from experimental BLS indexes for different income groups. The results generally concluded that the price change experience of the poor was similar to that of the broader population over the period researched (1984-94), though different formulas and aggregation methods affect the exact results.

Work by the Chicago Federal Reserve Bank continued along these lines, using BLS data to estimate price indexes for different demographic groups. McGranahan and Paulson (2006) presented the Chicago Fed Income Based Index (IBEX). The IBEX included inflation estimates by income quartile from 1983-2005, as well as inflation for food stamp vs. non-food stamp recipients, among other breakdowns. The data was subsequently extended through 2013. The results are hard to generalize but the long-term differences between groups are small. The lowest income quartile did have higher inflation than the population as a whole by just under 0.1 percentage point per year over the span. Curiously, though, food stamp recipients experienced a slightly lower inflation rate than non-food stamp recipients over the same period.

Studies such as Broda and Romalis (2009); Broda, Leibtag, and Weinstein (2009); Argente and Lee (2017); Jaravel (2017); and Kaplan and Schulhofer-Wohl (2017), have used AC Nielsen's (ACN) grocery and drug store transactions data to measure inflation rates for lower-income consumers versus other groups. These studies cover different time periods, and the data for the earlier time period is no longer available for replication. However, these studies are fairly consistent, showing a lower inflation rate for lower-income consumers from 1994 to about 2006, and then a higher inflation rate through 2015. They consistently find that lower income consumers substitute more in response to relative price changes, as measured by the spread between Paasche and Laspeyres indexes, which measures

[7] Michael J. Boskin, E. Dulberger, R. Gordon, Z. Griliches, and D. Jorgenson, "Toward a More Accurate Measure of the Cost of Living," Final Report to the Senate Finance Committee, December 4, 1996, http://www.ssa.gov/history/reports/boskinrpt.html/. [8] IRI data also covers this, but it comes from the same survey and respondent sources.

the differences in inflation from using the period *t* versus *t*+1 choices, and also by the estimated elasticities of substitution, which is a more direct, though stylized measure.

However, the ACN data is the only major data source currently available to study these effects at the level of individual goods as opposed to broad aggregates of goods, and it only covers about 8 percent of CPI expenditures, as measured by BLS samples of this data.[8] Since the relative inflation rates of lower-income consumers are also found to change over time, it is impossible to extrapolate any conclusions to the entire index for the indefinite future.

2.3 Original research on subpopulation inflation rates

Group members and public comment on the FRN brought up the issue of whether the inflation experiences of low-income consumers are the same as the population overall. Consumers with relatively lower income might have a higher budget share on goods with a different average inflation rate, or they might substitute between goods due to relative price changes to a different extent. The 2002 National Academies of Sciences report on cost-of-living and price measures *At What Price* stated:

> The existence of heterogeneity (*in purchasing patterns and shopping behaviors*) raises… important questions: First, are the rates of inflation experienced by different groups or by people in different geographic locations sufficiently different so that separate indexes should be constructed for each group or location? This issue is particularly important when indexes are used for adjusting taxes, social security benefits, and other public transfer payments.[8]

This section describes the ITWG's efforts to answer this question regarding the inflation experience of the poor.

The ITWG reviewed the existing economics literature to see if evidence existed of a different inflation experience among the poor. Since the indexes are all aggregated at two levels, first combining prices of goods into elementary item-area cells, and then combining cells weighted by expenditure shares, there are two ways to have different inflation rates. One is by different purchases within a cell, across goods and/or outlets, and the second is by different expenditure shares across cells. The literature only addressed the first possibility with consumer survey data from grocery and drug store transactions data, which represents only about 8 percent of the index.[9] The literature's conclusions are inconsistent over time, with the earlier period showing lower inflation for the poor and the later period showing higher inflation. For the second possibility of differences at the upper level of aggregation, the literature generally shows little difference, with at most a 0.1 percentage point higher average annual inflation for the lower-income consumers.

However, directly checking whether the upper level differences were significant was something the BLS was best able to do. The BLS created concurrent and lagged weighted indexes for a low-income

[8] National Research Council, At What Price? Conceptualizing and Measuring Cost-of-Living and Price Indexes. Panel on Conceptual, Measurement, and Other Statistical Issues in Developing Cost-of-Living Indexes, Charles L. Schultze and Christopher Mackie, Editors. Committee on National Statistics, Washington, DC. 2002. p. 246.

[9] This number is from internal BLS research using the same datasets as the papers referenced in the literature, comparing the data to Consumer Expenditure Survey data.

subgroup of the population, a chained consumer price index for poverty (C-CPI-P) and consumer price index for poverty (CPI-P), to compare to the C-CPI-U and CPI-U. This was done by using only a subpopulation of CE respondents to calculate different expenditure shares to weight the same elementary cell indexes. The same elementary indexes were used as for the CPI-U population, because for all component items, the BLS input data are not available to produce elementary indexes scientifically designed for the low-income subgroup.

Indexes were made for multiple definitions of the low-income population, including only those with CE reported income below the current OPM threshold, or targeting the OPM threshold itself with an income interval centered on the OPM threshold in different ways. In total, the BLS created three different experimental indexes for three different subgroup definitions for poverty.

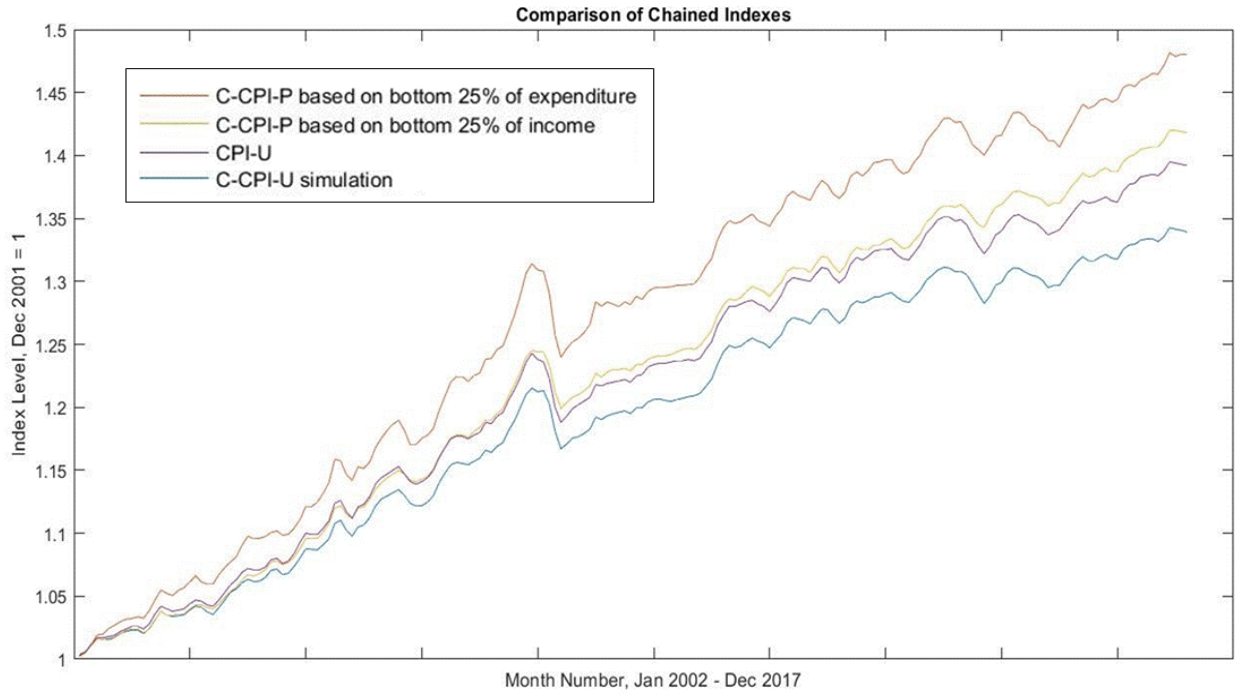
The ITWG found that all three experimental chained indexes showed higher inflation than the CPI-U from 2002 to 2018, which of course is higher than the C-CPI-U. A major reason was the higher weight for the poor on rent, which rose faster than the all items index over this span. This was partly offset by a lower weight for the poor on owners' equivalent rent, which also rose more quickly, but the net effect was positive. Other contributors included a higher weight on college tuition, textbooks and college housing, and energy and transportation. (See Appendix B.4 for a table showing the contributions to the differences by item.[10])

The sample sizes of respondents were quite small, however, ranging from 12.5 percent of respondents to 25 percent depending on the definition of the poverty cohort used. Due to the small household sample size, most elementary item-area cells had no reported expenditures for the one week (Diary) or 3-month (Interview) survey period, especially durable goods and infrequently purchased nondurable goods. Therefore, to see if the low sample sizes were driving the results through either high variance or some other bias, confidence intervals for the indexes were created by bootstrapping the CE population samples. Confidence intervals showed that the differences were statistically significant. (See Appendix B.5.) Defining the population by expenditure rather than income made the differences larger; see Chart 1.[11]

[10] Differences by item are reported between income and expenditure definitions for the poor, using the bottom 25% of the distribution, and between those populations and the entire population, for both index and shares. These are the sum of log differences summed over areas and months for the period 1999-2017. They are sorted by the highest to lowest of the difference between the income definition and the whole population, in an embedded Excel table.

[11] Research has shown that income, and the implied poverty rate, is very poorly measured by survey data, and expenditure can be a better proxy. See Meyer, Mok, and Sullivan (2015).

Chart 1



The group concluded there was sufficient evidence of different inflation between the average urban consumer and low-income urban consumers. The group also unanimously agreed that a newly created C-CPI-P type index specifically targeting a low-income subgroup and having purchases concurrent with prices would be the best index for the OPM. Therefore, the group recommends the BLS pursue the development and production of a new C-CPI-P and that the OPM be indexed to it.

The research conducted by the ITWG provides a proof of concept and feasibility for using existing data and resources to construct a C-CPI-P. It also identified several questions that BLS will need to further research and decide on as part of the process of constructing an official BLS statistical product, which are described in section 4.1.2. One issue is exactly what method of sample selection or weighting would be used to estimate the inflation rate for the OPM cutoff itself. Another issue is whether to identify the sample used in this estimation by income or expenditure. Also, indexes for rent and owner's equivalent rent could be constructed specifically for the OPM subpopulation, to see if it is feasible to use them and how best to construct them. (See section 4.1.2.) In the future, it may also be possible to redesign the CE to construct dedicated item-area indexes for the OPM subpopulation, by collecting data on individual purchases of specific items at specific outlets across different household income cohorts.

The other main charge of the group was to resolve remaining issues on index use, and to address historical index use including Census median income. This was done by incorporating the lessons and

decisions made by the group (see section 4.1) to propose a possible framework to aid agencies and private entities in choosing an appropriate index, which included Census median income as an example to support their review process.

SECTION 3: EXISTING FEDERAL MEASURES OF CONSUMER INFLATION

Federal statistical agencies currently produce several different measures of consumer inflation. These measures differ in their scope, methods, and intended uses or objectives.

3.1 BEA products

The BEA produces five measures of price change that receive much attention from macroeconomists. Three of them are aggregate in nature and are used to adjust nominal GDP for price change. These three are: the GDP Price Index, the GDP Price Deflator, and the Gross Domestic Purchases Price Index. The remaining indexes focuses on the price change for Personal Consumption Expenditures, which constitutes about 70 percent of GDP.

GDP Price Index: The GDP price index measures changes in prices paid for goods and services produced in the United States, including those exported to other countries. Prices of imports are excluded.

GDP Price Deflator: The GDP implicit price deflator, or GDP deflator, basically measures the same components and closely mirrors the GDP price index, although the two price measures are calculated differently. More specifically, it is derived implicitly as the ratio of the current-dollar value of GDP to its corresponding chained-dollar value, multiplied by 100. The GDP deflator is used by some firms to adjust payments in contracts.

Gross Domestic Purchases Price Index: The Gross Domestic Purchases Price index is BEA's featured measure of inflation for the U.S. economy. It measures changes in the prices paid by consumers, businesses, and governments in the United States, including the prices of the imports they buy.

Personal Consumption Expenditures Price Index: The PCE price index is a narrower measure. It looks at the changing prices of goods and services purchased by consumers (and includes goods and services provided by non-profit institutions serving households) in the United States. It's similar to BLS' consumer price index for urban consumers (CPI-U). In fact, because BEA does not collect any price data, the PCE price index is largely made up of CPIs and PPIs for a variety of goods and services. However, the two indexes have different measurement objectives and are constructed differently. Consequently, the monthly PCE and CPI inflation rates differ.[12] Also, BEA revises previously published PCE data to reflect updated information or new methodology, providing consistency across decades

[12] BEA provides a reconciliation of the inflation rates here in Table 9.1U. Reconciliation of Percent Change in the CPI with Percent Change in the PCE Price Index at: https://apps.bea.gov/iTable/iTable.cfm?reqid=19&step=2#reqid=19&step=2&isuri=1&1921=underlying.

of valuable data for researchers. The PCE price index is used primarily for macroeconomic analysis and forecasting.

Except for the PCE, BEA measures of price change are not designed to measure the price change experience solely of consumers, which makes them less appropriate for adjustments that affect consumers, including the thresholds of the OPM. While the PCE is more focused on consumers, its broader scope and use of some Producer Price Index data make it less appropriate for adjusting the OPM thresholds.

3.2 BLS products

To produce its inflation measures, BLS tracks the change in price of a scientifically selected sample of consumer goods and services over time. Those items are then weighted using household survey spending data to represent the experience of consumers in their day-to-day living expenses, with each of the CPI measures reflecting different item substitution rates, consumer populations, or other attributes.

Consumer Price Index for all Urban Consumers (CPI-U): The all urban consumer group is representative of about 93 percent of the total U.S. population. It is based on the expenditures of almost all residents of metropolitan or micropolitan areas, which are contiguous areas containing a population nucleus of at least 50,000 or 10,000 residents, respectively, together with adjacent counties that have a high degree of economic and social integration with that core. The population scope includes professionals, the self-employed, the unemployed, retired persons, as well as urban wage earners and clerical workers. Not included in the CPI-U are the spending patterns of people living in rural areas (defined as outside of any metropolitan or micropolitan statistical area), those in farm households, Armed Forces members and their families, and those in institutions such as prisons and psychiatric hospitals.

The CPI-U is used extensively (i) for a variety of statutory purposes as prescribed by Congress, (ii) in the calculation of other federal statistics, (iii) by federal, state, and local governments for administrative purposes, and (iv) by the private sector in escalation clauses of contracts.

Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W): The CPI-W corresponds closely to the population used in computing the CPI from its inception during the World War I era through 1978. The CPI-W represents the expenditures of households included in the CPI-U definition that also meet two additional requirements: more than one-half of the household's income must come from clerical or wage occupations, and at least one of the household's earners must have been a full-time worker, that is employed for at least 37 weeks during the previous 12 months. The CPI-W population represents about 29 percent of the total U.S. population and 31 percent of the CPI-U population. The CPI-U and the CPI-W are constructed using the same component indexes, and differ only in population coverage and the weights used to aggregate these components.

The CPI-W is used to calculate the annual cost-of-living-adjustment (COLA) applied to Social Security benefits and some other Federal transfer payments. The percentage of the population within the CPI-

W definition has declined over time, and the CPI-U, which was first published in 1978, has become more widely used.

Chained Consumer Price Index for all Urban Consumers (C-CPI-U): Both the CPI-U and C-CPI-U are indexes designed to measure price changes faced by all urban consumers. The C-CPI-U is distinguished from the CPI-U by the expenditure weights and price index formula used to produce aggregate measures of price change. The C-CPI-U employs a formula that reflects the effect of substitution that consumers make across component item categories, for example in response to changes in relative prices. The formula used in the CPI-U and CPI-W does not capture consumer spending response to changing relative prices across the component item categories.

The C-CPI-U formula uses expenditure data that are not available until several months after the reference month. Due to this lag in data availability, the C-CPI-U estimates for a reference month that are published alongside the CPI-U are calculated using a modeled estimate of consumer spending response. This preliminary published value is subsequently revised 10 to 12 months later when the actual expenditure data are available. The C-CPI-U was first published in 2002 and covers years 2000 to present.

Consumer Price Index for the Elderly (R-CPI-E): The R-CPI-E is a research index product that uses the same price surveys and formulas as the CPI-U and CPI-W, but uses expenditure weights for households with a reference person or spouse aged 62 years or older. As currently produced, the R-CPI-E captures the household budgets of the elderly population, which differ from the non-elderly population for notable items such as medical care and shelter. However, the sample of stores and specific goods and services used in the construction of the R-CPI-E are not scientifically selected based on the spending choices of the elderly population. In addition, the actual prices tracked month to month do not control for known third-degree price discrimination (i.e. senior citizen discount pricing).

The R-CPI-E is a research index and is not currently used for any known official purpose. BLS produces this index at the request of Congress and as mandated by statute.

Consumer Price Index Research Series Using Current Methods (R-CPI-U-RS): The Consumer Price Index Retroactive Series using current methods (R-CPI-U-RS) presents an estimate of the CPI for all Urban Consumers (CPI-U) from 1978 to present that incorporates most of the improvements made over that time span into the entire time series. The R-CPI-U-RS, therefore, provides an estimate of what the CPI-U would have looked like had current methodology been in place since 1978.

The R-CPI-U-RS is produced by adjusting the historical CPI-U series by estimates of the impact of methodological changes made since 1978. It does not involve applying the new methodology to the input micro-level sampled data.

3.3 Evaluating differences between existing indexes

The indexes published by BEA and the BLS differ in their measurement objectives, scope of population, geographic coverage, types of goods consumed, and methodology and data sources used to calculate the index.

3.3.1 Measurement objectives

The conceptual foundation for all BLS consumer inflation measures, referred to here as "CPI," is a cost-of-living index (COLI). As it pertains to the CPI, the COLI for the current month is based on the answer to the following question: "What is the cost, at this month's market prices, of achieving the standard of living actually attained in the base period?" This cost is a hypothetical expenditure—the lowest expenditure level necessary at this month's prices to achieve the base-period's living standard.

The ratio of this hypothetical cost to the actual cost of the base-period consumption basket in the base period is the COLI. Unfortunately, because the cost of achieving a living standard cannot be observed directly, in operational terms a COLI can only be approximated. Although any BLS CPI cannot be said to equal a cost-of-living index, the concept of the COLI provides the CPI's measurement objective and is the standard by which bias in the CPI is defined.

The CPI-U, CPI-W, and R-CPI-E all attempt to approximate the change in the cost of living for their respective populations. The R-CPI-U-RS attempts to define the past change in the cost of living based on current CPI methods. The C-CPI-U also attempts to approximate the change in the cost of living, but it is less constrained than the other measures in that it is based on contemporaneous expenditure weights rather than fixed weights based on a past period.

3.3.2 Scope: Consumption and geographic coverage

The CPI provides an approximation to a conditional COLI, pricing consumer goods and services. Except for the exclusions below, all consumer goods and services are eligible for pricing in the CPI; the CPI does not attempt to price only necessities or exclude certain classes of goods and services.

Goods and services (such as raw steel, business software, or commercial space) not typically purchased by individuals and households are out of scope. Free goods, the quality of the environment, goods provided by the government at no cost, and the value of leisure time, are all out of scope despite affecting the cost of living as broadly defined.

Excluded goods and services: The CPI covers the consumption sector of the U.S. economy, which is defined as the purchase of goods and services for use by households. Consequently, it excludes investment items, such as stocks, bonds, real estate, and business expenses. Life insurance is also excluded for this reason, although health, household, and vehicle insurance are in scope. Employer provided in-kind benefits are viewed as part of income rather than consumption. Purchases of houses, antiques, and collectibles are viewed as investment expenditures and are therefore excluded. Gambling losses, fines, cash gifts to individuals or charities, and child support and alimony payments also are out of scope. Interest costs and finance charges are also out-of-scope. The CPI excludes illegal goods and services and the value of home-produced items because of the practical difficulties of collecting the data.

Government-provided and government-subsidized items: The CPI treats any changes to fees that the government charges for items, such as admission to a national park, as in-scope changes in price. The CPI also counts the price of subsidized items that are available to the general public. For example, governments may subsidize local transit operation. If the subsidy is cut and the fare is raised, the CPI will reflect this as a price increase. On the other hand, the CPI does not reflect changes to means-tested subsidies (dependent on the recipient's income), such as the Supplemental Nutrition Assistance Program (SNAP) or section 8 housing allowances. Changes in such subsidies are treated as changes to the recipient's income and are out of scope.

Taxes: The CPI excludes income tax and other direct taxes; however, it does include the effects of changes in sales taxes and other indirect taxes paid on consumer products. No attempt is made to reflect changes in the quantity or quality of government services paid for through taxes.

Items: Some specific items mentioned by respondents in the CE survey might not be priced for practical reasons such as difficulties in sampling; in such cases the weight of those items is moved by price change by other items in the same category.

Geography: Geographically, the scope of the CPI is the entire United States, including all states but excluding territories. A geographic sample is drawn based on the Decennial Census; the current CPI geographic sample is based on the 2010 Census.

3.3.3 Methodology

The CPI is created from a series of interrelated surveys. The CPI requires:

- The Decennial Census which is used to select a geographic sample (i.e., a set of core-based statistical areas where prices will be collected);
- A survey of consumer expenditures (BLS Consumer Expenditure Survey; CE) to create and appropriately weight a market basket of goods and services to be priced and to create a sample of outlets in which prices are collected;
- A survey of retail establishments for the collection of prices of consumer commodities and services (BLS Commodities and Services Survey; C&S); and
- A survey of rental housing units (BLS CPI Housing Survey).

Weights: Weights for all CPI measures are based on household surveys of consumer expenditures. This contrasts with the PCE and reflects the focus of the CPI; it is designed as a cost-of-living measure and attempts to measure the price change experience of consumers for items they use for everyday living. The weights in the CPI reflect the spending patterns of the target population. Note the scope of the CPI excludes investment products, changes in intertemporal prices (interest rates), and the purchase price of houses. (Changes in rent are used to measure changes in the opportunity cost of owner-occupied housing.)

With the exception of the C-CPI-U, CPI weights are based on surveys done in the past. CPI indexes from 2018 and 2019, for instance, were based on BLS' Consumer Expenditure Survey (CE) data from

2015 and 2016. There is an implicit assumption that consumer behavior does not change across item categories; effectively the quantities of the goods and services are held constant over time.

Estimation of basic indexes: Each month, the processing of the BLS' C&S and housing survey data yields a set of price relatives, a measure of short-term price change, for all component indexes. The CPI uses an index number formula to obtain an average price change for the sampled items in each component index's sample. Most component items, termed *elementary item strata* in BLS jargon, use the geometric mean index formula, which is a weighted geometric mean of price ratios (a sampled item's current price divided by its price in the previous period) with fixed weights equal to the item's expenditure share within the component cell for the sampling period.

Calculations for a limited number of strata use a modified Laspeyres index number formula, which is a ratio of the sum of current period prices weighted by base period quantities to the sum of the previous month's prices by base period quantities, with the base period corresponding to the two year period during which consumer expenditures were surveyed.

The CPI-U, CPI-W, and R-CPI-E are all based on the samples of outlets and prices and differ only in the expenditure weights of the different item categories.

Aggregation: Except for the C-CPI-U, basic indexes are aggregated into the broader published indexes using a Laspeyres formula. This holds quantities fixed and does not account for consumer substitution across item categories. In fact, the CPI-U, CPI-W, R-CPI-E, and R-CPI-U-RS all treat consumer behavior as unchanged since the period of BLS's CE survey used to compute expenditure weights. Since consumers generally change their purchases in response to relative price changes, this use of a Laspeyres formula with weights from a base period a few years old results in a biased estimate of price change relative to the cost-of-living measurement objective of the CPI.

In contrast, the C-CPI-U uses a Tornqvist formula to average price changes across item categories, averaging the weights from the two months used in calculation (for example, the May C-CPI-U would be used based on weights from April and May). These weights are not obtained until 10-12 months after initial publication, however, so the initial C-CPI-U is estimated using a CES or Lloyd Moulton price index formula, and revised when the weight data are available.

The C-CPI-U is considered a more accurate measure of the change in the cost of living since it is based on current consumer behavior and is free of the substitution bias that arises in the other measures from the assumption of unchanged consumer behavior. However, the fact that the C-CPI-U is revised after initial publication creates complications for its official use.

3.3.4 Biases and other limitations of CPI measures

The CPI is subject to several types of bias. Most of these biases apply to all the CPI measures. Additionally, there are other limitations that apply to CPI measures that should be kept in mind when evaluating the usefulness of CPI data.

New Goods Bias: The CPI may fail to capture the increase in consumer welfare generated by new goods. If a price index incorporates a new good into its sample immediately upon introduction, it will capture some of the increased consumer welfare generated by the new good by capturing the decline

in price that typically happens in the early stages of a new good. However, it is operationally difficult to get new goods (or meaningfully new varieties of existing goods) into the sample without some time lag.

The BLS has taken steps in recent decades (including more frequent weight updates and sample rotation) to incorporate new goods into the CPI sample more quickly, but realistically the CPI does not capture the full price decline from introduction. Additionally, some new goods may generate welfare gains that are hard to quantify regardless of how quickly they might be introduced into the sample. So, it is unlikely the CPI fully reflects the welfare increases generated by new goods.

Quality change bias: Quality change bias is the failure to properly adjust for changes in the quality of goods and services. Conceptually, quality change bias could be in either direction. While it is more often alleged that the quality change bias leads to the CPI overstating inflation because it fails to fully capture quality increases, some do assert that the CPI overstates quality increases, or fails to measure quality declines.[13]

While the CPI uses several methods to estimate quality change, some quality change may be difficult to quantify (for instance, the increased capabilities of smartphones). While there is disagreement over the magnitude and even the direction of quality change, the difficulty of measuring quality change is an important complication to be aware of in assessing CPI measures.

Substitution bias: Substitution bias arises when the CPI fails to capture the impact of consumers changing their purchasing habits in reaction to changes in relative price and substituting toward relatively cheaper goods. It can be helpful analytically to distinguish between lower level and upper level substitution bias. Lower level substitution bias refers to substitution between similar items within a category (specifically a CPI basic index, which is within a specific item and area). Upper level bias refers to substitution across the boundaries of these categories. So, substitution between cuts of beef would be lower level; substitution from beef to chicken would be upper level.

The CPI since 1999 has used a geometric means formula which assumes a degree of substitution at the lower level (except in selected categories where such substitution is unlikely). This substantially eliminates lower substitution bias. However, except for the Chained CPI-U, CPI measures are calculated with an assumption of no upper level substitution, since the Laspeyres formula used to calculate upper level indexes implicitly makes that assumption.

Outlet bias: Outlet bias refers to the failure by the CPI to capture increases in consumer welfare from changing outlets, usually from higher priced outlets to lower priced outlets. The CPI sample contains specific items in specific stores, so welfare gained by a consumer by purchasing the same items at a new, lower price store isn't explicitly captured in the CPI.

Outlet bias may be mitigated by the fact that the CPI would indirectly capture such gains if new lower price outlets put downward pressure on prices in existing outlets. It might also be argued that the

[13] See. e.g., Bart Hobijn, On Both Sides of the Quality Bias in Price Indexes, Staff Report 157 (Federal Reserve Bank of New York, 2002).

new outlets are not perfect substitutes to higher price ones, in that they may be less convenient or offer less service.

Small sample bias: Small sample bias arises because, when samples are small, the expected value of the geometric average of price changes in the sample will tend to be higher than the actual geometric price change of all price changes for that item and region. Small sample bias is widely considered to be relatively minor compared to other types of bias.

Other limitations: In addition to the several types of bias, CPI measures have other limitations that users should consider. CPI measures are subject to sampling error. In 2017 the CPI-U All items 12-month change had a median standard error of 0.07 percent. Additionally, CPI measures are affected by any biases or limitation of the surveys used as inputs. For example, if participants in the BLS' CE used to create upper level weights in the CPI underreport their tobacco purchases, the weight in the CPI for tobacco will not reflect actual expenditures. Some price index experts have expressed concerns about chain-link bias in high-frequency chained indexes, such as the monthly C-CPI-U. The hypothesis is that the monthly chained version will 'drift' over long periods of time, either systematically higher or lower, compared to a bimodal estimate of price change over the historical period.[14] There is little evidence of chain link biases over the 20-year history of the BLS C-CPI-U index at the broad, all-items level.[16]

3.3.5 Strengths and weaknesses of specific CPI measures

All CPI measures are based on the same sample of outlets and prices, and generally subject to the same biases and limitations. The CPI-U, CPI-W, and R-CPI-E differ only in the population whose spending habits is used to calculate the weights of the item categories. The C-CPI-U uses the same population as the CPI-U but uses different time periods for its weights and a different formula than the other measures. The R-CPI-U-RS is the same as the CPI-U during the current time period, but is a different historical time series as it attempts to adjust the CPI-U from earlier periods based on the impact of new methodology. The C-CPI-U uses the same basic indexes as the CPI-U, but uses more recent weights and a different formula to aggregate the indexes.

The following is a summary of the general applicability strengths and weaknesses of the various BLS CPI products, in regard to use as the OPM inflator.

CPI-U (Consumer Price Index for All Urban Consumers)

Population: The CPI-U is based on the expenditures of almost all residents of urban or metropolitan areas, including professionals, the self-employed, the unemployed, and retired people, as well as urban wage earners and clerical workers. Not included in the CPI are the spending patterns of people living in rural nonmetropolitan areas, those in farm households, people in the Armed Forces, and those in institutions, such as prisons and mental hospitals.

[14] See, e.g., de Haan, Jan. Estimating chain drift in price indexes based on scanner data. Journal of Econometrics, Vol. 161, Issue 1, March 2011, pp 36-46.
[16] BLS members of ITWG shared some preliminary analysis of chain drift in the Chained CPI, from a forthcoming BLS Monthly Labor Review publication that is planned on the subject. Expected publication is fall 2020 or winter 2021.

Strengths: The CPI-U is the broadest and most widely used CPI and is based on the spending patterns of the broadest subset of the population. Sampling and other decisions are made based on the CPI-U. Other CPI measures might be seen as derivations of the CPI-U, based on either the spending patterns of a subset of the U population (R-CPI-E, CPI-W), alternative aggregation of CPI-U basic indexes (C-CPI-U), or adjustments to the CPI-U historical series (R-CPI-U-RS).

Weaknesses: It may be argued the CPI does not accurately capture the inflation experience of certain subgroups, including those impacted by changes in poverty thresholds. The spending data used to compute the weights of the CPI-U includes spending of virtually all consumers, including very wealthy consumers whose market basket may be very different from those at the margin of poverty.

CPI-W (Consumer Price Index for All Urban Wage Earners and Clerical Workers)

Population: The CPI-W is based on the expenditures of households included in the CPI-U definition that also meet two additional requirements: more than one-half of the household's income must come from clerical or wage occupations, and at least one of the household's earners must have been employed for at least 37 weeks during the previous 12 months.

Strengths: The CPI-W is based on the spending patterns of a subset of the population that, while not equivalent to the poor or those near the poverty threshold, would tend to exclude most wealthy households and so might be a better proxy for the market baskets of those at the margin of the poverty threshold. The CPI-W is used to adjust Social Security COLAs and other federal payments.

Weaknesses: The definition of the CPI-W population presents conceptual challenges. The percentage of the population that meets the CPI-W definition has shrunk over time and no longer corresponds to an economically meaningful subset of the population

R-CPI-E (Research Consumer Price Index for Americans 62 Years of Age and Older)

Population: The R-CPI-E is based on the spending patterns of households included in the CPI-U definition in which the reference person is 62 or older.

Strengths: As with the CPI-W, it might be argued the population of the R-CPI-E has spending patterns more similar to the spending of those near the margin of poverty than the broader CPI-U population.

Weaknesses: The R-CPI-E is considered a research index rather than an official index, and has never been used in any official capacity. It uses the same sample, prices, and outlets as the CPI-U, so it does not reflect the fact that the elderly might purchase different items, shop at different places, or in some cases pay different prices than does the non-elderly population.

C-CPI-U (Chained Consumer Price Index for All Urban Consumers)

While the CPI-U, CPI-W, and R-CPI-E differ only in the population coverage, the C-CPI-U differs from the other measures in several ways. While the other measures have weights that are based on a base period of consumer expenditures that are a few years old, the C-CPI-U is based on spending patterns of the same population as the CPI-U, but (for the final version) uses weights contemporaneous to the months involved in the calculation. Additionally, the C- CPI-U uses a different formula to aggregate

indexes than the other measures. Whereas the other measures use a Laspeyres formula, the C-CPI-U uses a Tornqvist formula that averages the weights from the two months involved in calculation.

The C-CPI-U, unlike the other measures, is revised. It is subject to multiple revisions and the final version is not available until 10 to 12 months after initial publication. The C-CPI-U is initially estimated using a CES (constant-elasticity-of-substitution) formula and then made final when the expenditure weight data for the relevant months become available.

Population: Same as CPI-U

Strengths: The C-CPI-U may be a more accurate measure of the change in the cost of living than other CPI measures because it is nearly free of upper level substitution bias. The use of more up-to-date expenditure data and the Tornqvist formula allow the C-CPI-U to reflect actual consumer behavior, rather than assume quantities of goods and services purchased remains constant, as the other indexes implicitly do. Additionally, small sample bias is less of an issue for the C-CPI-U.

Weaknesses: The Chained index is subject to multiple revisions and the final version is not available until 10 to 12 months after initial publication. Any official use of the C-CPI-U must wrestle with revision issues, which is not the case for the other measures. In addition, some may argue the use of the C-CPI-U is inappropriate for adjustment of poverty thresholds because those near the margin of poverty may have more limited ability to substitute than other consumers. This criticism is not rooted in the formula used in the C-CPI-U, but rather its population scope. The formula, a monthly chained Tornqvist, resolves to a Laspeyres in an environment of little consumer substitution. That is, if the spending weights used in the Tornqvist actually reflect consumer behavior which is fixed quantity (little substitution), then the Tornqvist and Laspeyres will closely approximate one another. However, if high-income households substitute a lot while low-income households do not, then an index representing all households along the income distribution might not be appropriate. Some might also argue that if low-income families experience higher inflation than the broader population, the C- CPI-U will exacerbate the underestimation of price change for the low-income population, given it tends to run slightly lower than other CPI measures. Others might argue that even if the poor experience higher inflation than the broader population, the CPI-U may still overstate inflation for all groups (including the low-income population) due to other sources of upward bias, and thus, the C-CPI-U could better approximate price changes for the poor than the CPI-U.

R-CPI-U-RS (Consumer Price Index Retroactive Series Using Current Methods)

The retroactive series using current methods (R-CPI-U-RS) presents an estimate of the CPI for all Urban Consumers (CPI-U) from 1978 to present that incorporates most of the improvements made over that time span into the entire series. So, the series is a variant of the CPI-U but is different historically in that it is adjusted by estimates of the impact of methodological changes made since 1978. The R-CPI-U-RS is very similar to the CPI-U for recent years but quite different before 1999.

Population: Same as CPI-U

Strengths: Historical CPI data from before 1999 and especially before 1983 reflect a CPI that used a substantially different methodology. The R-CPI-U-RS arguably provides a more accurate measure of historical price change since it reflects estimates of the impact of methodological improvements.

Weaknesses: The R-CPI-U-RS is considered a research index rather than an official index, and has been used officially only in a limited way. Most estimates are based on BLS research covering a short period of time and extrapolated to a longer period. Therefore, there is considerable uncertainty surrounding the magnitude of the adjustments. (Although the larger adjustments, notably for rental equivalence and geometric means, are careful estimates based on long term simulations.)

Additionally, there have been several improvements in the CPI not incorporated into the R-CPI-U-RS, either because they do not represent changes in methodology, because they had negligible impacts on the CPI's growth rate, or because it was impossible to systematically estimate the impacts of the new methods in past years.

SECTION 4: ITWG RECOMMENDATIONS TO OMB

The ITWG was asked to provide two recommendations to OMB: how should the OPM be adjusted for inflation and whether there is a need for OMB to provide guidance to federal agencies on the use of various inflation measures. This section presents our recommendations to OMB and discusses how we reached these recommendations.

Recommendation 1: Official Poverty Measure

The ITWG developed cohort consumer price indexes for households at the lower end of the income distribution, in order to explore the inflation experience of a low-income subset of the population. The results of this research indicate low-income cohorts tend to have different budget shares than the overall urban population which, when applied to the data from 2004 to 2017, resulted in higher estimates of inflation for these cohorts. The ITWG recommends the BLS pursue development of a new consumer price index specifically designed to represent the inflation experience of low-income consumers, and that OMB use that new index to adjust the OPM. To that end, a formula measuring price change based on the current behavior of consumers is superior to one based on consumer behavior from several years ago. Therefore, an index that uses the Tornqvist (or a similar formula that averages spending from adjacent time periods) should be used in the construction of the low-income index. (See section 4.1.)

Recommendation 2: Need for OMB guidance

Evaluating a given price index's fitness for a particular purpose requires an understanding of the strengths and weaknesses of the various indexes available, and also a comprehensive understanding of the specific use under consideration. ITWG determined that any guidance OMB could disseminate on the fitness for use would be of little value to agencies, because guidance could only reasonably consider the measures themselves in isolation from any potential specific agency use. ITWG recommends the BLS provide additional resources to assist users on index choice. (See section 4.2.)

4.1 Recommendations on the index best suited for the Official Poverty Measure

OMB asked the ITWG to prepare a final recommendation on the consumer inflation measure most appropriate for conducting annual adjustments to the OPM thresholds. This section provides background on the OPM and on inflation adjustment in general, then describes the specific thought process and intermediate decisions of the ITWG.

4.1.1. The ideal index for OPM annual calculation

With so many different indexes available, and additional indexes often requested by users, Federal statistical agencies face a tension between the goals of providing indexes tailored for specific purposes of public policy and avoiding public confusion that might result from too many indexes to choose amongst. We start by conceptually examining the specific purpose of the index in the OPM calculation and then arrive at an appropriate index tailored for OPM use with respect to population coverage, market basket definition, and aggregation methodology.

We began our deliberations by asking ourselves "what features would an ideal index for adjusting the OPM thresholds have?" The specific purpose of the consumer inflation measure as used in the OPM is to convert a set of known, historical dollar value numbers into current year dollar value numbers. That is, it is used as an inflator — a predictor of the current year dollar value of a previously estimated dollar value. In that context, this section examines the proper population, consumption, and aggregation scope.

What population? The first overarching conceptual issue that must be addressed when making an index choice is whether the adjustment contemplated should compensate recipients for changes in the overall costs of living for the nation as a whole, or whether it should take account of any significant differences among particular groups or individuals in society. In the case of the OPM, the choice is between the use of a broad index representing the overall population versus a narrower index representing the inflation experience of the low-income population.

According to the Committee on National Statistics (CNSTAT), if purchasing patterns diverge widely and if prices of items marking the big differences change at significantly different rates, the idea of creating group-specific sub-indexes becomes compelling. If consumption bundles are proportionally similar, or if price changes across group-differentiated bundles consistently balance out, index disaggregation may be superfluous and may reduce precision of price change estimates. In this scenario, a broad index tailored to represent the inflation experience of the general population would be sufficient as proxies for group-specific purposes.[15]

In economics, Engel curves describe how household expenditures vary with income: primarily as income increases, the budget share spent on food decreases.[16] This pattern can be seen in CE data, indicating that purchasing patterns do diverge by income. Additionally, ITWG work has shown that inflation rates differ by income as well (i.e., the indexes for different populations were also measured

[15] National Research Council, At What Price? Conceptualizing and Measuring Cost-of-Living and Price Indexes. Panel on Conceptual, Measurement, and Other Statistical Issues in Developing Cost-of-Living Indexes, Charles L. Schultze and Christopher Mackie, Editors. Committee on National Statistics, Washington, DC. 2002, p. 246.

[16] See https://www.britannica.com/biography/Ernst-Engel#ref86426.

to be statistically significantly different as described in the statistical appendix). Thus, ITWG decided a sub-population target is better than a full-population target based on both economic theory and empirical verification of the criteria established by CNSTAT.

Principle A: The target for the index to adjust the OPM threshold is the change in expenditure needed to purchase the standard of living as defined by the official poverty threshold from a consistent, given reference year. There is sufficient evidence that purchasing patterns diverge widely and the prices of goods and services that mark this divergence change at significantly different rates for several reasonable subgroup definitions constructed to represent low-income consumers, and therefore creation of a group-specific sub index is compelling.

Exactly what set of prices should be included? The second overarching conceptual issue is the market basket scope of the index: exactly what items should be included in the measure. Traditionally, consumer inflation measures limit the set of prices to those paid by consumers for personal use or consumption. That is, prices for items purchased for investment or for business are excluded. As the ILO manual states: the CPI is not a measure of general inflation, as it only measures changes in the prices of consumer goods and services purchased by households. A CPI does not cover capital goods, such as the purchase of a house, or the goods and services consumed by enterprises or the government. Any attempt to analyze inflationary pressures in the total economy must also take account of other price movements, such as changes in the prices of imports and exports, industrial inputs and outputs, and asset prices.

Since the ITWG recommends the target population of the OPM index inflator to be a set of households, this necessarily limits the consumption scope of the index to those items purchased by households. The term *consumption* is imprecise, and its interpretation could lead to a different CPI scope. The ILO defines consumption as: *"an activity in which persons, acting either individually or collectively, use goods or services to satisfy needs and wants."* [17]

In economics, consumption is measured by the value of goods and services either wholly or partially used up in some period, or by the value of the goods and services acquired for eventual use. Households may acquire goods and services for consumption in four distinct ways:

- By purchase in a monetary transaction;
- By producing or growing them for their own use;
- As a payment in-kind for remuneration, such as for work done; and
- By receipt as a gift or transfer.

Generally, the scope of a CPI is limited to items purchased in a monetary transaction, and excludes household production, in-kind transfers, and gifts. The BLS consumer price indexes adopt an

[17] International Labour Office, et. al. Consumer Price Index Manual Theory and Practice, ILO/IMF/OECD/UNECE/Eurostat/The Word Bank, Geneva, Switzerland. 2004, p. 39.

'acquisition cost' approach as the valuation definition of consumption: the full out-of-pocket expense to the household incurred to acquire the good or service, at the time of acquisition, excluding finance charges. The set of items to include in a CPI is usually termed the CPI *market basket*. The BLS market basket is structured on eight major groups: food and beverages, apparel, transportation, medical care, recreation, education and communication housing, and other goods and services. It excludes pensions, life insurance, taxes, gambling, and fines.

For the purpose of the OPM, the ITWG considered two possible market baskets: all consumption items included in the CPI market basket and a subset basket limited to only food items. On one hand, the original Orshansky poverty thresholds[18] were chiefly based on the cost of a subsistence food budget and then simply multiplied by a scalar adjustment to approximate a subsistence level for all consumption items. On this view, one might argue only price changes for food should be used, in combination with the same or updated scalar multiplier, as the mechanism to convert the prior year threshold values to current year. (See Appendix B.2 for an estimate using this approach). On the other hand, the Orshansky thresholds when viewed in their entirety, represent spending on more than just food – on all items needed for subsistence. Under this view, the full CPI market basket would be deemed appropriate. The ITWG recreated the Orshansky thresholds under two different conditions: using updated food costs and the same fixed multiplier as the original scalar adjustment (3X), and using updated food costs and updated scalar adjustments based on the percent of total expenditures on food reported in BLS' CE data. (See Appendix B.6 for the results of these analyses.)

Principle B: The OPM has been adjusted by an inflation measure representing all consumption goods and services since its inception. There is no strong basis for recommending a change, and therefore an all-items CPI remains the relevant concept.

What type of formula? The third overarching conceptual issue is how to aggregate the price movements of the components included in the consumption scope or market basket. Mathematically, there are numerous types of formulas from arithmetic to geometric, weighted and unweighted. As described in section 3, the BLS uses a variety of formulas. This section explains the economic underpinnings of those decisions.

A common approach typically used by statistical agencies to choose an index formula is the economic approach to price index theory. In the case of the consumer and the retail marketplace, this approach espouses to select the index formula that best corresponds to consumer utility maximization and consumer behavior. Under consumer utility theory, consumers are hypothesized to be utility maximizers subject to their income (resource) constraints. The term *utility* is generally defined as the satisfaction derived or expected to be derived from the consumption of goods and services.[19] Hence, it is a conceptual object that is difficult if not impossible to measure.

[18] *See https://aspe.hhs.gov/history-povertythresholds#:~:text=The%20poverty%20thresholds%20were%20originally,of%20the%20Social%20Security%20Administration.&text=She%20derived%20poverty%20thresholds%20for,derived%20from%20the%201955%20survey.*

[19] See https://financial-dictionary.thefreedictionary.com/Utility+(economics).

In classical economics, when faced with changing prices of goods and services, consumers are hypothesized to behave in such a way as to maximize utility. The traditional cost-of-living index concept assumes if all environmental conditions are constant and equal between two periods, with the exception of changing relative prices of consumer goods, then consumers will alter their spending behavior such that they will make the minimum outlay (expense) in the current period to achieve the same standard of living (utility) as they achieved in the base period. This minimum-expenditure-to-obtain-a-fixed-level-of-utility theory is the assumption behind the cost-of-living approach to price index formula. Under this approach, the price index formula to choose is the one that best corresponds with the utility function of the average consumer.

In turn, a fundamental conceptual distinction may be drawn between a basket index and a cost-of-living index. A basket index is an index that measures the change between two time periods in the total expenditure needed to purchase a given, fixed set or basket of consumption goods and services. This is sometimes referred to as a cost-of-goods or COGI index. In economics, this index corresponds to a Leontief consumer utility function; consumers respond to changing relative prices by consuming the same fixed-quantity bundle of items as they purchased in the previous period. The Leontief function assumes in order to achieve the same base-period utility in a current period, the consumer must purchase the exact same items in the exact same quantities. That is, the consumer is completely indifferent to price change (i.e., has price inelastic demand for the items possessed, consumed, and used). The Laspeyres index, used by BLS in upper-level aggregation for the CPI-U, corresponds to Leontief utility preferences.

A cost-of-living index approach, or COLI index, recognizes consumers may substitute among items when faced with changing relative prices, in order to achieve the same level of utility at a lower expense. For example, if the price of a movie ticket increases relative to the price of a restaurant meal, a consumer may choose to substitute away from theatre going and toward dinner out on the town as a way to achieve the same level of 'entertainment' in the two pricing situations. Symmetrical index formula, those that make use of the prices and quantities in both periods compared, are deemed more appropriate and closer approximations to cost-of-living indexes when consumers exhibit some substitution behavior. Popular symmetrical index formulas include the Fisher Ideal (as used in the PCE-PI), the Tornqvist (as used in the C-CPI-U), the Sato-Vartia, and the Walsh.[20]

Nonetheless, one can interpret both a COGI and COLI as indices that aim to measure the change in expenditure needed to purchase either the same basket or two baskets whose composition may differ somewhat but between which the consumer is indifferent. If, in reality, consumers do exhibit Leontief or fixed-quantity behavior, then a COLI index and a COGI index would approximate one another very closely. For this reason, most economists prefer a COLI to a COGI formula if the purpose of the index is to more closely approximate a cost-of-living-index.

The C-CPI-U uses a Tornqvist formula and utilizes expenditure data in adjacent time periods in order to reflect current consumer behavior, meaning that expenditures correspond to the same period as prices. The final C-CPI-U estimate of price change to a given month *t* from month *t*-1 is based on an

[20] Diewert, W.E. Exact and superlative index numbers. Journal of Econometrics. Volume 4, Issu2, May 1976, pp 115-145.

average of consumer expenditures in months *t* and *t*-1, which will be referred to as the current period. Other CPI measures use a Laspeyres formula with fixed weights that are updated biennially. So, the measure or price change to month *t* from month *t*-1 is based on consumer expenditure data that are several years old. (For example, CPI-U indexes in 2018 and 2019 were based on expenditure data from 2015 and 2016.)

While the choice between these approaches is often framed in terms of accounting for consumer substitution in reaction to changes in relative prices, or in some cases as representing a choice between a COLI and COGI approach, it need not be. It seems intuitively reasonable that a measure of current price change is best estimated based on consumer behavior facing the current array of goods and prices than a different array of goods and prices faced in the past. Indeed, recognizing the value of more recent weights in producing a more accurate measure of price change, the BLS has in recent years undertaken great efforts to reduce the time lag between surveys of consumers and expenditures and their use in the CPI, implementing new surveys more frequently and reducing the processing time. Still, the ITWG acknowledges the time currently required to produce a final index based on a COLI approach using a Tornqvist formula is a challenge that would need to be addressed for timely release of poverty estimates using this method.

One may note that the fixed-weight Laspeyres formula implicitly assumes consumer behavior remains unchanged between the time of the expenditure survey and the measure of price change. The C-CPI-U makes no significant assumption about consumer behavior. If consumer behavior is in fact unchanged, then the formulas will yield nearly the same results; if it is not then the C-CPI-U is a more accurate measure of price change in the current period.

Principle C: A formula measuring price change based on the current behavior of consumers is superior to one based on consumer behavior from several years ago. Therefore, an index that uses the Tornqvist (or a similar symmetrical formula that incorporates weights from adjacent time periods) should be used to adjust the OPM, subject to addressing implementation timing issues.

4.1.2 Creating a new chained CPI for low-income households

The principles described in the previous section led the ITWG to conclude that existing indexes are not ideally suited to adjust the OPM, and that the BLS should pursue the creation of a new official subgroup index, a Chained CPI-P or C-CPI-P. There are many issues to be decided about how to construct this new C-CPI-P. The BLS should research, consult with relevant subject matter experts, and decide how to resolve these issues.

The first issue is how to define the subpopulation, and what criteria will be used to identify the CE respondents included in the new *P* population definition. The target for the C-CPI-P as described above is the inflation rate for the OPM threshold itself; however, any given CE sample will have few or no respondents with income or expenditure exactly equal to the current year OPM cutoffs. While the ITWG experimented with different ways to use the CE sample to define the *P* cohort, these may not necessarily be the most efficient or accurate ways possible. One possibility is to include respondents at or near the threshold itself, since that is what is being adjusted and would be the target consistent with the data and economics for dividing the population into higher and lower living

standards. This definition would likely only be useful for this specific OPM use. A second possibility is to include only those respondents whose income is below the OPM thresholds, because this cohort definition would have broader applications and could be used for other purposes related to the inflation experience of low-income consumers. This approach has the drawback that it is not the population at or near the threshold itself, and depends on an accurately adjusted threshold to define the below-threshold population.

A second issue is whether a plutocratic weighted index, where each household is weighted by expenditures, is preferred to a democratic index, where each household is equally weighted. An index meant to define society's welfare costs, market conditions, or output would imply a plutocratic index, while one that targets the average inflation of particular individuals would imply a democratic one. Making an index for the OPM would require consideration of this in deciding how to calculate it with the available sample.

A third issue is whether the use of establishments, items, and housing units sampled for the urban population is appropriate for the new poverty population. For example, the research C-CPI-P developed for this report only differs from the C-CPI-U by the expenditure share weights for item area elementary cells that are aggregated to make the indexes — not by the elementary cell indexes themselves. Each elementary cell index is constructed by aggregating price relatives for each sampled good in the cell. The goods are sampled based on a probability proportional to expenditure share. For most goods, it is not possible with existing data to calculate elementary cells for the OPM cutoff cohort. There may be ways in the future, however, if the CE is redesigned and sample expanded. The BLS should research and incorporate elementary cells for the OPM index as feasible given budget constraints.

The BLS should explicitly explore whether housing sample data can be re-weighted to address this issue. For shelter services (rent and owner's equivalent rent (OER)), it may be possible to create low-income specific elementary indexes simply be reweighting the existing all-urban housing sample. Currently, both rent and OER use the same survey sample of rents, though some rents are excluded from use in OER. The most important cause of differential in movement between rent and OER is the difference in weight shares by neighborhood. The weights are the share of each neighborhood that rents versus owns. These weights are calculated from the CE and American Community Survey (ACS) based on data that are lagged by eight years or more. However, the data do exist to weight neighborhoods by the share of low income (or income or expenditure near the OPM) residents, thus creating elementary indexes for the OPM that also use more current data. Currently, the items that make up a large majority of the difference between the C-CPI-U and research C-CPI-P produced for this report, are rent and OER. Lower income households have a higher weight on rent and a lower weight on OER, and because for recent years rent has had higher inflation than OER, the net effect is a higher all-item inflation estimate as measured by the C-CPI-P relative to the C-CPI-U. This is such a large effect because shelter — rent and OER combined — represents the largest component part of the CPI, around a third of expenditures. Therefore, anything that happens with rent prices can have a very large effect on the difference between the all-urban and low-income cohort indexes.

A fourth issue is whether income or expenditure is the best variable to define the OPM cutoff. While the official poverty definition is by income, research has shown income is often misreported in survey data, as compared to more reliable administrative data.[21] The CE is designed to measure expenditures, and the income items are not critical to the primary purpose of the survey. Therefore, income could be measured especially inaccurately in the CE. The target of the C-CPI-P is the change in expenditure needed to purchase a given standard of living. Preliminary research by ITWG has found that a C-CPI-P defined by expenditure is higher than one defined by income, in part because of the higher weight on rent for the low-income population. This is consistent with an expenditure definition being a less noisy measure and thus including lower income households on average, who would then have even lower average rent shares. The expenditure definition also puts lower weight for low-income households on college tuition, which is also consistent with a definition that contains lower income households. (See appendix B.4.)

A fifth issue is whether to broaden the definition of the poverty subpopulation to include rural areas. The current urban population does not include rural consumers, but rural consumers are included in the Census definition of poverty. BLS has developed research indexes that add weight for rural residents, even though no prices are sampled from rural areas. The C-CPI-P could be made using these weights.

A sixth issue is to determine the specific aggregation scheme to produce reliable monthly weights for a subpopulation. BLS has not produced chained versions of subpopulation indexes in the past because of CE data constraints. One reason the R-CPI-E is published as a research index is the relatively smaller sample of CE respondents used to construct its weights. A chained version would further tax the CE sample to produce monthly estimates of expenditures. Resolving this issue could entail an aggregation scheme that employs a Laspeyres formula across geography (employing an assumption about consumer substitution between cities) and a Tornqvist formula across items.

Dealing with revisions to the Chained CPI

A primary feature of the C-CPI-U and the proposed chained CPI for the poverty population (C-CPI-P) is that they are aggregated with expenditure weights that reflect the actual purchasing decisions of consumers.[22] With this desirable feature, however, also comes a defect: publication of the C-CPI-U arrives with a delay of 10 to 12 months, a delay that arises because of the lag in reporting and processing consumer expenditures.[23] In contrast, the CPI-U does not have this problem because the aggregation weights—also known as the market baskets—are not current. For the most recent 9 to 11 months, the BLS estimates a preliminary version of the C-CPI-U by aggregating the component item-area indexes (the same ones used in the monthly CPI-U) with a CES aggregation formula. This CES formula works fairly well, but still makes small errors that become evident only in hindsight.

[21] See Meyer, Mok, and Sullivan (2015).

[22] If and when the consumers buy (say) more beef and less chicken, the Tornqvist aggregation formula used in the chained indices ensures that the chained indexes reflect that reconfiguration of the market basket without imposing any theoretical constraints.

[23] Although prices are reported with a lag of one month, the consumer spending weights needed to aggregate them are derived from the Consumer Expenditure Survey, and that reporting system involves a delay.

For data users that do not require such timely measures of prices, this reporting lag is not important as they can use the final value of the chained index for their analysis. However, data users that require timely chained price indexes are left with a choice. They must decide whether to:

1) use the preliminary version of the index and adjust the index each year in such a way that is self-correcting so that the error in the preliminary CES estimate does not accumulate or compound over time, or

2) use the final version of the index for a prior period and accept a mismatch between the period covered by the price index and the ideal period.

This problem has been recognized by previous studies that recommended use of the C-CPI.[24]

We will use the example of adjusting the poverty thresholds to elaborate on these points. It is not the intention of the ITWG to recommend which of these methods would be most appropriate for adjusting poverty thresholds. In the example below, we will assume the existence of the C-CPI-P in the discussion for simplicity. In general, users of the various versions of the chained CPI must think carefully about the production schedule for the final version of the chained CPI and their proposed application.

The production process for the OPM for a given year (y) begins with the calculation of income thresholds by family size and number of children in January of the following year ($y+1$), and publication of weighted averages by family size in September of $y+1$.[25] In January and September of $y+1$, only the preliminary estimate of the C-CPI-P would be available. Below we discuss how the Census Bureau could adjust the poverty thresholds.

Updating Poverty Thresholds with the Preliminary C-CPI-P

In order to update the thresholds so that the income reporting period (year y) matches the period used for the price index, the Census Bureau would need to use the preliminary C-CPI-P for year y. We will denote the final price index for year y as P_y and the preliminary index as P_y^p. Because $P_p(y)$ is preliminary, it will likely have some error e_y, so that

$$P_y^p = P_y + e_y. \qquad \text{(Eq.1)}$$

In the year that C-CPI-P escalation of the OPM thresholds begins, calculations could be based on the latest year for which C-CPI-P is finalized. Suppose, for example, that the escalation were to begin with the 2020 OPM—with the calculation of the 2020 income thresholds in January 2021. At that date,

[24] See pages 5-7 of Congressional Budget Office (2010) "Using a Different Measure of Inflation for Indexing Federal Programs and the Tax Code" https://www.cbo.gov/sites/default/files/111th-congress-2009-2010/reports/cpi_brief.pdf, or pp 10-12 of Congressional Budget Office (2013), "Using the Chained CPI to Index Social Security, Other Federal Programs, and the Tax Code for Inflation" https://www.cbo.gov/sites/default/files/113th-congress2013-2014/reports/44083_ChainedCPI.pdf, or conclusion 7-1 of (page 11) of National Research Council (2002), "At What Price?: Conceptualizing and Measuring Cost-of-Living and Price Indexes. Washington, DC, The National Academies Press.

[25] The poverty thresholds can be found at https://www.census.gov/data/tables/time-series/demo/income-poverty/historical-poverty-thresholds.html. In September, the Census Bureau releases the "Weighted Average Poverty Thresholds for Families of Specified Size," which are used as inputs into the calculation of the Poverty Guidelines that are used to determine eligibility for means-tested program benefits such as Medicaid and Supplemental Nutrition Assistance Program (SNAP), among others. For more information on the Poverty Guidelines, see https://aspe.hhs.gov/poverty-guidelines.

calculations could be based on the OPM for 2019, the final C-CPI-P for 2019 (P_{2019}), and the preliminary C-CPI-P for 2020 (P_{2020}^{p}), as follows:

$$OPM_{2020} = OPM_{2019}\frac{P_{2020}^{p}}{P_{2019}}. \quad \text{(Eq.2)}$$

In subsequent years, escalation of the OPM could continue to use this formula, but only if the base year is frozen at 2019. That is:

$$OPM_{y} = OPM_{2019}\frac{P_{y}^{p}}{P_{2019}}. \quad \text{(Eq.3)}$$

Because of the nature of the preliminary estimate, the error in the P_{y}^{p} will affect the OPM in that year, but not subsequent years. To see why, we can rewrite (Eq.3) using (Eq.1) as:

$$OPM_{y} = OPM_{2019}\frac{P_{y} + e_{y}}{P_{2019}}. \quad \text{(Eq.4)}$$

The presence of the e_{y} term in (A.4) shows the error in the preliminary estimate will also result in error in the poverty threshold. By keeping the base year fixed (in this case for 2019), only the error of each year's preliminary estimate will affect the poverty thresholds. However, if we updated the thresholds from one year to the next, that would not be the case.

To see why, suppose we can define thresholds updated each year from the thresholds in the prior year as:

$$OPM_{y}^{p} = OPM_{y-1}^{p}\frac{P_{y}^{p}}{P_{y-1}}. \quad \text{(Eq.5)}$$

In this example, we use the final estimate in -1, P_{y-1}, because the preliminary estimates are no longer available on the BLS website after the release of the final estimates. In 2020, the result would be the same as in (Eq.4), with the error from 2020 only. However, in 2021 the result would be:

$$OPM_{2021}^{p} = OPM_{2020}^{p}\frac{P_{2021}^{p}}{P_{2020}}. \quad \text{(Eq.6)}$$

If we replaced the OPM_{2020}^{p} and OPM_{2021}^{p} with the versions from (Eq.4) and (Eq.1), we would get:

$$OPM_{2021}^{p} = OPM_{2019}\left(\frac{P_{2020} + e_{2020}}{P_{2019}}\right)\left(\frac{P_{2021} + e_{2021}}{P_{2020}}\right). \quad \text{(Eq.7)}$$

The important takeaway from (Eq.7) is that the error term from *each* year's preliminary estimate affects the thresholds. When we adjust the thresholds from a baseline year as in (A.4), the updates are "self-correcting", as only the error from the most recent year's price index affects the thresholds.

Updating Poverty Thresholds with the Most Recently Available Final C-CPI-P

Alternatively, the September publication schedule of the OPM could be maintained by using the Q2-to-Q2 increase in the C-CPI-P, as the final chained price index for Q2 (April-June) is released in April the following year. The downside of this approach is the income used in the OPM calculation is reported for calendar year y whereas the prices used to adjust the incomes would come from May in year $y-1$ through April in year y. If after April there were large movements in one of the volatile components of the CPI, such as gasoline, these would not be reflected in the inflation adjustments.

$$OPM_y = OPM_{y-1}\frac{P_{Q2,y-1-Q2,y}}{P_{Q2,y-2-Q2,y-1}}. \qquad \text{(Eq.8)}$$

4.1.3 Provisional options for OMB to consider

Until an index with a population scope targeting low-income households constructed using a Tornqvist aggregation formula is officially ready for use in OPM calculations, what are the intervening options that OMB could consider for adjusting the OPM? The ITWG did not reach a consensus on which of the following options is best, though a majority favored no change to the current methodology during the interim period (option 2). Itemized below are the three key options we considered along with their arguments.

Option 1 – Research version of the C-CPI-P: Use an unofficial, research version of a C-CPI-P that BLS could ostensibly start publishing monthly within a year or two. This product would be based on the methodology used in simulations produced by the ITWG, but might not sufficiently address the issues listed in the previous section. This is currently the best estimate available of the ideal, conceptual index ITWG prefers. It is also the best index for the BLS to hammer out methodological questions through learning-by-doing. It may be a challenge, however, to use an unofficial index product to revise an official Federal statistic.

Option 2 - CPI-U: Continue to use the CPI-U. If there is a planned change to the OPM calculus in the near future (C-CPI-P when it is released as official), it is costly to change the methodology in the interim – and then to follow on the heels of that with another change. This may cause the public to think the government, either Census or OMB, is tinkering with the statistic for policy reasons. A challenge in retaining the CPI-U during an interim period may be that it does not take into account some improvements made to other indexes (such as the C-CPI-U) and it would not represent the current knowledge (based on ITWG analysis) of the inflation experience of the low-income population.

Option 3 – Chained CPI-U: Switch to the C-CPI-U. It is preferred over the CPI-U in general based on formula and mitigation of substitution bias. The ideal index C-CPI-P differs from the current index used in the OPM calculation in two basic ways: upper level formula and population target, so switching to the C-CPI-U gets us halfway to incorporation of the ideal index. ITWG analysis, however, showed the experimental C-CPI-P produced by the group was closer to the CPI-U than the C-CPI-U over the entire study period (2004 to 2017).

4.2 OMB guidance for federal agencies on index use

The ITWG was charged by OMB to consider the feasibility of OMB guidance on the fitness for use of the different consumer inflation indexes. The ITWG does not believe formal OMB guidance is feasible.

Evaluating fitness for use requires a good understanding of the strengths and weaknesses of the different indexes, but it also requires a comprehensive understanding of the specific use under consideration. The ITWG determined any guidance OMB could feasibly generate on the fitness for use would be of little value to agencies because it would only be able to consider the measures themselves in isolation from any potential specific uses. (See section 5.)

Instead, we recommend the BLS provide better support to public and Federal users in choosing among indexes. Knowledge of the uses is needed in choosing an index, as it helps guide users to an index based on their specific needs and circumstances.

SECTION 5: REMAINING ISSUES IN NAVIGATING APPROPRIATE USE OF INFLATION MEASURES

OMB asked the ITWG to prepare and submit a report to the Chief Statistician containing recommendations on the remaining issues around appropriate use of existing inflation measures, including for adjusting Census Bureau historical figures, that takes into account the public comments received from the FRN.

The following is intended to tie together lessons learned and agreed upon principles into a more general framework to include the remaining issues of the use of inflation measures to answer the charter charge. Its purpose is also to provide aid to the Census's review of the adjustment of the Census Bureau historical median income series, and to support the BLS' intention to provide guidance to the public on index choices. The following provides one example of such guidance, which the BLS could revise as needed. It can also aid other agencies and private entities until such BLS guidance is available.

5.1 Adjusting long-running historical series

The ITWG identified the challenges associated with adjusting long-running historical series as a major remaining issue that could benefit from our input. Federal statistical agencies and researchers want to adjust long running data for inflation using the most appropriate methods available, but depending on the time frame and the goals of the adjustment, different methods may be appropriate.

For example, the Census Bureau uses the R-CPI-U-RS to adjust their median historical income figures because that index is designed to represent a consistent historical series covering the time period from 1978 forward by incorporating most of the improvements made over that time period into the entire series. The Census Bureau recently initiated a review of their use of this index to adjust their historical income series and to consider potential alternatives. This review process will include the

release of research and working papers on the topic, presentations at professional conferences, expert group meetings to solicit feedback from external subject matter experts, and additional appendix information in the official income and poverty report.

5.2 Background

The options currently available for adjusting historical series include the CPI-U (1913-present), the PCE price index (1959-present), the C-CPI-U (2000-present), the *initial* C-CPI-U values, which are published in real time but later revised (2000-present), the CPI-W (1978-present), and the R-CPI-E (1982-present). In addition, this report recommends the publishing of a C-CPI-P, which is not yet available, and other indexes that may become available in the future.

Several of the more theoretically advanced models are relatively recent in their time range while use of an index might necessitate a longer time range. In these cases, combinations of the indexes could be used over different time ranges. For example, the CPI-U could be used from 1913-1959, the PCE index from 1959-2000, and the C-CPI-U from 2000 onward. Additionally, any guidance regarding index use should also look forward and attempt to cover the possibility of new indexes that might become available.

5.3 Existing indexes

CPI-U: The CPI-U (1913-present) is a Lowe index, which uses a modified Laspeyres formula with weights based on purchases of consumers; these purchase weights could be lagged by ten years or more depending on the time range (as opposed to current weights). The CPI-U is the longest running headline CPI, covering periods no other published index series does. Therefore, for the time range of 1913-1959, the CPI-U may be the best index available by default.

CPI-W: The CPI-W (1978-present) is also a Lowe index with the same weight lag as the CPI-U, but it uses purchases only of urban wage earners. This was the headline CPI until 1978, when the historical CPI was renamed the CPI-U. Use of the CPI-W as an index choice might be desired for a historical series that simply records what was used at the time regardless of what would have been ideal.

R-CPI-E: The R-CPI-E (1982-present) is also a Lowe index similar to the CPI-U and CPI-W, but the purchases are for the elderly population, age 62 or older.

PCE Index: The PCE index (1959-present) aggregates price data from CPI, PPI, and BEA, and used a Fisher formula starting in 1978. The Fisher formula uses consumer purchases that correspond to the same period as the prices in the index, and the PCE index also uses the R-CPI-U-RS for many elementary inputs when available. The R-CPI-U-RS recalculates or extrapolates the elementary indexes for improvements made since the indexes were first made, and so is the current best estimate for those elementary indexes. The aggregation weights used are targeted toward deflating national accounts however, so the PCE index is most appropriate for such output-focused uses. However, it could be used for consumer-focused purposes if a better-suited index is unavailable given the time period.

C-CPI-U: The C-CPI-U (2000-present) aggregates elementary CPI cells by a Tornqvist formula using current weights from consumer purchases. The use of those weights makes it desirable to index measures of consumer welfare. The C-CPI-U final values are not available for the most recent month, however, as these weights take time to process. Instead, initial values are published with available data and final values are later published when ready.

5.4 Proposed guidance on index selection

Appendix A.3 is a flowchart and Appendix A.4 an accompanying overview document which details a decision-tree method for choosing among indexes. Several use-case examples are detailed including the OPM and Census Median Income.

The following list of principles is in order of priority to help users chose among the best possible improved indexes.

For a given time range,

1. An index with current purchases is better than one with lagged purchases (principle C).
2. Specific population-targeted indexes are better for uses related to their targeted population than general indexes (principle A).
3. A revised index is better than an unrevised index.
4. A recalculated revised index is better than an extrapolated one.
5. An index targeted to consumers is better for a consumer income measure (principle B).
6. An official index is better than a research series of similar nature.

Therefore, this implies:

- The C-CPI-U could be used if consumer wellbeing is the target when available for a time range.
- The PCE index could be used when producer output is the deflation target, or the C-CPI-U is not available for that time range period needed and if the range needed is not before 1978.
- The CPI-U could be used when neither the C-CPI-U nor the PCE index is available for a given range.
- If a new version of the index for the range that would have been used is available that targets the relevant subpopulation or dollar amount, that index is consistent with the principles instead.
- If a new version of the index for the range that would have been used is available that better recalculates the elementary indexes, that index be used instead.

Clearly, if an agency is required by law to use a certain index, or if there is a historical series with the goal of only recording what was done, not what should have been done, then there is no reason to use this framework.

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Appendix A

Appendix A.1: OMB Statistical Policy 14

FEDERAL REGISTER, VOL 43, NO. 7-THURSDAY, MAY 4, 1971

Directive No. 14 Definition of Poverty for Statistical Purposes.

For the years 1959-1968 the statistics on poverty contained in the Census Bureau's Current Population Reports, Series P-60, No. 68, shall be used by all executive departments and establishments for statistical purposes. For the years 1969 and thereafter, the statistics contained in subsequent applicable reports in this series shall be used. A number of Federal agencies have been using statistical series on the number of persons and families in poverty, and their characteristics, in analytical and program planning work. The basis for these series has been the classification of income data collected by the Bureau of the Census in accordance with a definition of poverty developed by the SSA and revised by a Federal Interagency Committee in 1969. This definition provides a range of income cutoffs adjusted by such factors as family size, sex of family head, number of children under 18 years of age, and farm-nonfarm residences. The Bureau of the Census series continues the SSA definition for the base year, 1963, except that the differential between poverty levels for farm and nonfarm families is reduced from 30 percent to 15 percent. Annual adjustments in Census series are based on changes in the average annual total consumer Price Index (CPI) instead of changes in the cost of the U.S. Department of Agriculture's Economy Food Plan. The establishment of this standard data series does-not preclude departments and agencies from more detailed analyses or from publication of tabulations for specialized needs although, where applicable, totals must agree with totals published by the *Bureau of the Census. Other measures of poverty may be developed for particular research purposes, and published, so long as they are clearly distinguished from the standard data series. The poverty levels used by the Bureau of the Census were developed as rough statistical measures to record changes in the number of persons and families in poverty and their characteristics, over time. While they have relevance to a concept of poverty, these levels were not developed for administrative use in any specific program and nothing in this directive should be construed as requiring that they should be applied for such a purpose.

Appendix A.2: Federal Register Notice, consumer inflation measures ITWG

OFFICE OF MANAGEMENT AND BUDGET **Request for Comment on the Consumer Price Indexes Produced by Federal Statistical Agencies**

AGENCY: Executive Office of Management and Budget (OMB)

ACTION: Notice of solicitation of comments

SUMMARY: Under the *Budget and Accounting Procedures Act* of 1950 (31 U.S.C. 1104 (d)) and the *Paperwork Reduction Act* of 1995 (44 U.S.C. 3504 (e)), the Office of Management and Budget (OMB) issues a request for comments on the differences among the various consumer price indexes produced by the Bureau of Labor Statistics (BLS) and the Bureau of Economic Analysis (BEA).

In its role as coordinator of the Federal statistical system under the *Paperwork Reduction Act,* OMB, among other responsibilities, is required to ensure the efficiency and effectiveness of the system. A key method used by OMB to achieve this responsibility is the promulgation, maintenance, and oversight of Government-wide principles, policies, standards, and guidelines concerning the development, presentation, and dissemination of Federal statistical products. OMB's Office of the Chief Statistician relies on public comment and subject matter expertise across the Federal government to identify areas where existing OMB policies or guidance may be out of date, lacking clarity, or insufficient for efficient coordination of Federal statistics.

Accordingly, OMB is seeking public comment on the strengths, weaknesses, and best practices for the application of the following consumer inflation measures: the Consumer Price Index for All Urban Consumers (CPI-U), the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W), the Chained Consumer Price Index for All Urban Consumers (C-CPI-U), the Consumer Price Index Research Series (CPI-U-RS), and experimental Consumer Price Index for Urban Elderly Consumers (CPI-E), all produced by BLS, and the Personal Consumption Expenditures price index (PCEPI) produced by BEA.

Issues for comment: OMB is interested in receiving comments from the public on: (1) The intended scope and purpose of each of the indexes under consideration; (2) The strengths and weaknesses of the indexes for different applications or uses; (3) The strengths and weaknesses of the use of the CPI-U to make annual adjustments to the Official Poverty Measure, as established in OMB's Statistical Policy Directive #14, and discussion of potential alternative indexes; (4) The strengths and weaknesses of the different indexes for making annual adjustments to the historical income figures produced by the Bureau of the Census; (5) The need for and feasibility of guidance from OMB or other Federal source on the appropriate or best practice use of the different indexes; (6) Recommendations for the use of the PCEPI and C-CPI-U for the production of official statistics, considering that both measures are revised after initial release.

Dates:

Comments on the strengths, weaknesses, and appropriate uses of the various consumer inflation measures produced by Federal statistical agencies must be in writing. To ensure consideration of comments, they must be received no later than 45 days from the publication of this notice. Please be aware of delays in mail processing at Federal facilities due to increased security. Respondents are encouraged to send comments electronically via email, or through *http://www.regulations.gov* (discussed in **ADDRESSES** below).

ADDRESSES: Comments may be addressed to: Nancy Potok, Chief Statistician, Office of Management and Budget, fax number (202) 395-7245. Email comments may be sent to *Directive No. 14@omb.eop.gov*, with the subject "Directive No. 14". Alternatively, comments may also be sent via *www.regulations.gov*—a Federal E-Government website that allows the public to find, review, and submit comments on documents that agencies have published in the Federal Register and that are open for comment. Simply type "OMB-2019-00XX" (in quotes) in the Comment or Submission search box, click "Go", and follow the instructions for submitting comments. Comments received by the date specified above will be included as part of the official record.

Comments submitted in response to this notice may be made available to the public. For this reason, please do not include in your comments information of a confidential nature, such as sensitive personal information or proprietary information. If you send an email comment, your email address will be automatically captured and included as part of the comment that is placed in the public docket. Please note that responses to this public comment request containing any routine notice about the confidentiality of the communication will be treated as public comments that may be made available to the public notwithstanding the inclusion of the routine notice.

Electronic Availability: This document is available on the internet on the OMB Web site at: *https://[to be inserted]*

FOR FURTHER INFORMATION CONTACT:

For information about this request for comments, contact Bob Sivinski, Office of Management and Budget, 9257 New Executive Office Building, 725 17th St. NW, Washington, DC 20006, telephone (202) 395-1205, *email Directive No. 14@omb.eop.gov* with the subject "More Info: Directive No. 14".

Supplementary Information

Measuring Inflation

Inflation is defined as a rise in the general level of prices (and deflation a decline in the general level of prices). Equivalently, inflation represents a decline in the purchasing power of money. Adjusting statistics and other data for inflation may better reflect consumers' actual experiences over time. The inflation measures produced by BLS and BEA were developed for different purposes through rigorous technical processes. They are continually evaluated to ensure they are objective, accurate, relevant, and timely, thereby maintaining the integrity of official government statistics.

Uses of Different Inflation Measures

Congress sometimes requires agencies to use a specific inflation measure for specific programs. For example, public law Pub.L. 115–97 directs the IRS to adjust federal income tax brackets for inflation with the C-CPI-U. In other instances, Congressional guidance may be absent or less specific, and agencies exercise their discretion in choosing an index to calculate inflation-adjusted statistics. In cases where Congress has not specified a specific methodology, agencies should use the measure of inflation most appropriate for the intended purpose of the program's needs, consistent with maintaining the integrity of the inflation measure's intent.

The different indexes produced by the Federal statistical agencies differ in their scope, weighting, and formulas. OMB will be considering how these differences might impact the estimation of the Official Poverty Measure and other income measures produced by the Census Bureau. OMB will also consider the need for guidance to Federal agencies on the differences among the indexes.

BLS Consumer Price Indexes

In order to produce its inflation measures, BLS tracks the change in price of a sample of consumer goods and services over time. The sample is intended to represent the experience of consumers in their day-to-day living expenses, with each of the CPI measures reflecting different item substitution rates, consumer populations, or other attributes. OMB is seeking comment on the five following indexes produced by BLS.

The Consumer Price Index for all Urban Consumers (CPI-U)

The all urban consumer group represents about 93 percent of the total U.S. population. It is based on the expenditures of almost all residents of metropolitan or micropolitan areas. The population scope includes professionals, the self-employed, the unemployed, retired persons, as well as urban wage earners and clerical workers. Not included in the CPI-U are the spending patterns of people living in rural areas, those in farm households, Armed Forces members and their families, and those in institutions, such as prisons and mental hospitals.

The CPI-U is used extensively for official purposes. In addition to the official poverty thresholds, it is used to adjust Treasury Inflation-indexed securities, to deflate nominal values in a variety of measures, and until recently to adjust federal tax brackets.

The Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W)

The CPI-W is based on the expenditures of households included in the CPI-U definition that also meet two additional requirements: more than one-half of the household's income must come from clerical or wage occupations, and at least one of the household's earners must have been a full-time worker, that is employed for at least 37 weeks during the previous 12 months. The CPI-W population represents about 29 percent of the total U.S. population and 31 percent of the CPI-U population. The CPI-U and the CPI-W share the same components (item strata) and differ only in population coverage and the weights used to aggregate these components.

The CPI-W is used to adjust Social Security benefits and many other Federal transfer payments. The percentage of the population within the CPI-W definition has declined over time, and the CPI-U, which was first published in 1978, has become more widely used. The CPI-W corresponds closely to the population used in computing the CPI from its inception during the World War I era through 1978.

The Chained Consumer Price Index for all Urban Consumers (C-CPI-U)

Both the CPI-U and C-CPI-U are indexes designed to measure price changes faced by urban consumers. The C-CPI-U is distinguished from the CPI-U by the expenditure weights and price index

formulas used to produce aggregate measures of price change. The C-CPI-U employs a formula that reflects the effect of substitution that consumers make across component item categories, for example in response to changes in relative prices. The formula used in the CPI-U and CPI-W does not capture consumer spending response to changing relative prices across the component item categories.

Because the expenditure data used in the C-CPI-U formula is not available until several months after the reference month, the C-CPI-U is estimated ahead of time and revised later, becoming final 10 to12 months after initial publication. The C-CPI-U was first published in 2002.

The Experimental Price Index for the Elderly (CPI-E)

The CPI-E uses the same price surveys and formulas as the CPI-U and CPI-W, but uses expenditure weights for households with a reference person or spouse aged 62 years or older. As currently produced, the CPI-E captures the household budgets of the elderly population, which differ from the non-elderly population for notable items such as medical care and shelter. However, the CPI-E does not capture that the elderly population might shop at different places, purchase different specific products and services, or in some cases receive specific price discounts.

The CPI-E is an experimental index and not currently used for official purposes.

The Consumer Price Index Research Series Using Current Methods (CPI-U-RS)

The consumer price index research series using current methods (CPI-U-RS) presents an estimate of the CPI for all Urban Consumers (CPI-U) from 1978 to present that incorporates most of the improvements made over that time span into the entire series. The CPI-U-RS therefore provides an estimate of what the CPI-U would have looked like had current methodology been in place since 1978.

The Personal Consumption Expenditures Price Index (PCEPI)

In addition to the BLS CPI measures described above, OMB also seeks comment on the PCEPI chain type price index produced by BEA.

The PCEPI is a measure of the prices that people living in the United States and nonprofit institutions pay for goods and services. The PCEPI uses mainly CPI series along with some PPI series, also produced by BLS, and price indexes from other Federal agencies. The PCEPI differs from the CPI in weighting, formula, and scope. A summary of these differences can be found at the BEA website: https://www.bea.gov/help/faq/555. The PCEPI is compiled monthly and quarterly and both are revised routinely unlike the official CPI-U and CPI-W series, which are not revised.

More information on these measures can be found at the BLS website: https://www.bls.gov/cpi/ and the BEA website: https://www.bea.gov/data/personal-consumption-expenditures-price-index

The Official Poverty Measure

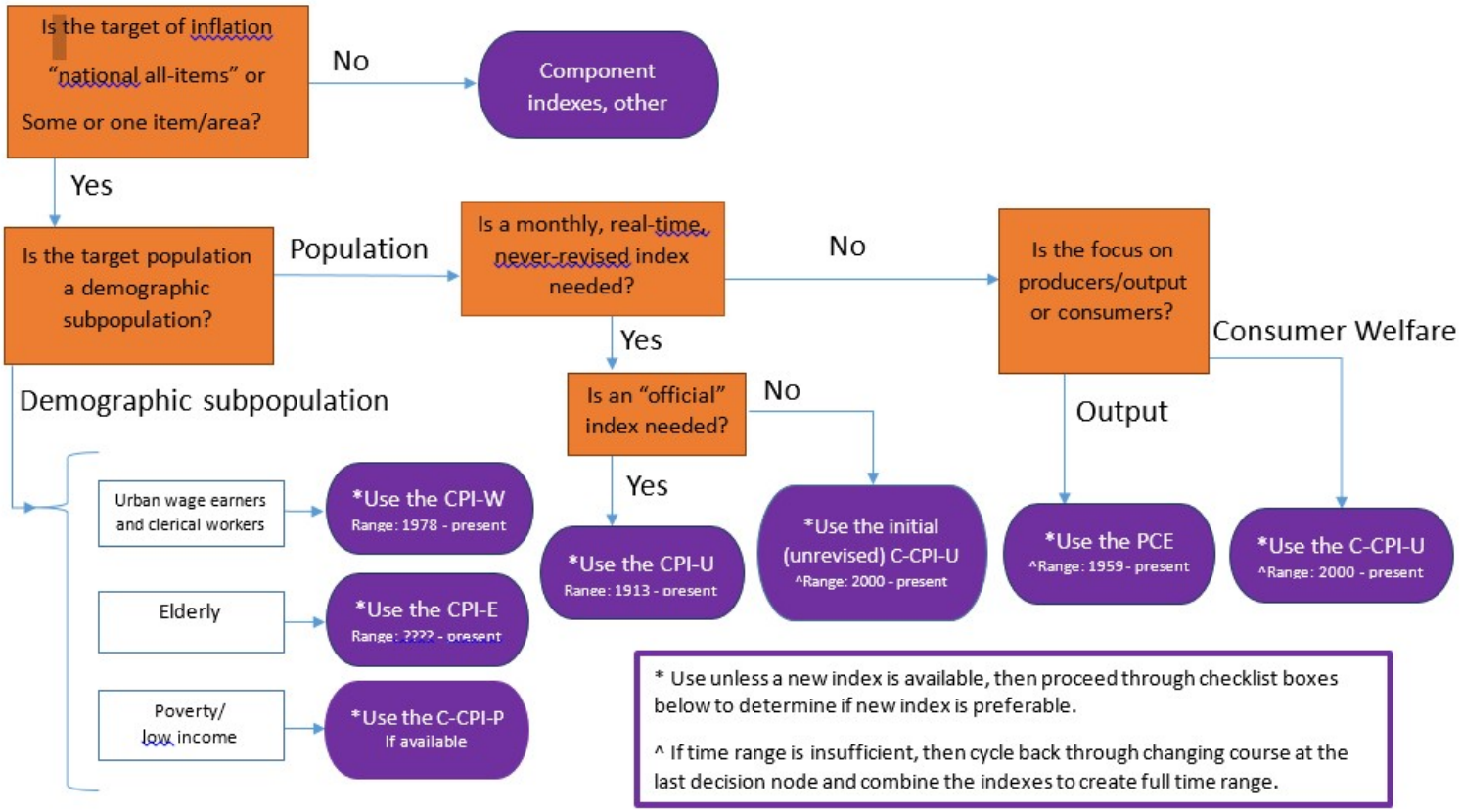
OMB's Statistical Policy Directive 14 (SPD#14), issued in May 1978, specifies the use of the Consumer Price Index (CPI) in the annual adjustments of poverty thresholds (the Official Poverty Measure, or OPM) calculated and published by the Census Bureau. Specifically, the directive states:

Annual adjustments in Census series are based on changes in the average annual total Consumer Price Index (CPI) instead of changes in the cost of the U.S. Department of Agriculture's Economy Food Plan.

In practice, the All-items, U.S. City Average Consumer Price Index for All Urban Consumers (CPI-U), produced by the Department of Labor, Bureau of Labor Statistics (BLS), has been the index used for the annual adjustments. This policy has not been reevaluated since the introduction of new consumer inflation measures, such as the Chained CPI-U (C-CPI-U). OMB is currently reevaluating the appropriateness of the use of the CPI-U for annual adjustment in the Official Poverty Measure. To assist in this reevaluation, OMB assembled an interagency technical working group to study an array of possible price change measures and make a recommendation to OMB on revising the current method for adjusting the OPM. The comments received under this Notice will be reviewed and considered by the technical working group in development of their recommendation to OMB.

The poverty thresholds should not be confused with the poverty guidelines, produced annually by the U.S. Department of Health and Human Services. While the poverty thresholds are used for calculating official poverty population statistics, the guidelines are used for administrative purposes. Most commonly they are used by a number of federal, state, local, and non-profit programs, such as Medicaid and the Supplemental Nutrition Assistance Program (SNAP) to determine income eligibility. The guidelines are based on the previous year's poverty thresholds, and updated for inflation using the CPI-U, based on statutory language in the Community Services Block Grant Act (42 U.S.C. 9902(2)). Because of this, changes to the poverty thresholds may affect eligibility for programs that use the poverty guidelines. OMB is not currently seeking comment on the poverty guidelines or their application. More information on the poverty guidelines can be found at: https://aspe.hhs.gov/poverty-guidelines.

Appendix A.3: All purpose index decision-making flowchart



Checklist boxes for newly available indexes. If "no" to all, stay with choice(s) in purple; if "yes," to any, continue to check all boxes and use the index version mentioned in the checkbox farthest to the right.

Is a previously more preferable choice newly available for the time range?	Is there a version with current purchases available?	Is there a version with recalculated-revised indexes available?	If the target is the cost of living of median income earners, is there a version that also target the median income level itself?

Appendix A.4: Index choice flowchart documentation

This flowchart is a proposed starting point to help users decide upon the best index for them to use based on statistical principles and index availability at the time. It can be fine-tuned with more experience using it. The flowchart is currently designed only for choosing among national all items indexes, and not for index components. The orange boxes are questions for the user to answer, and purple boxes are possible end decisions (see Appendix A.3). Some examples of how the flowchart could be used are listed below.

A flowchart design challenge is how to allow for the possibility of superior future indexes being published. The current solution is to include a set of checklist boxes on the bottom row. It could be the case that multiple improved indexes are made, which is why the boxes are all listed in the current order with the priority of principles increasing to the right. This is to make sure that even if there is an improvement, another index which has even more improvements is not overlooked.

Also, a desired index may not be available for a time range of a historical series. In that case, the user is advised to restart the flowchart ignoring the unavailable option for that time range only, in order to pick the next best index. Then there may be only one option for an orange box regardless of the question, or the user may have to back up one box if there are no options. The changes in the different indexes can then be used in different time ranges to make a continuous series. The hybrid series would thus change at the rate of one index for a given time range, and then change at the rate of the other index for another time range.

A glossary of terms is below to make the flowcharts clearer, followed by examples of its use including the Official Poverty Measure and Census Median Income.

Glossary

CPI-U: Headline CPI for urban (U) consumers population, does not use current purchases

C-CPI-U: Chained CPI for urban (U) consumers, uses current purchases

R-CPI-U-RS: Research series for CPI-U, a revised historical series that calculates or extrapolates the effects of current practices on the CPI-U 1978-1999

CPI-W: A CPI for the wage earners (W) population

C-CPI-W: A proposed chained CPI-W

R-CPI-E: A CPI for the elderly (E) population

C-CPI-E: A proposed chained CPI-E

C-CPI-P: A proposed chained CPI for the poverty (P) population or the poverty line

PCE index: The personal consumption expenditures index series made by the BEA

Revised series: A series that calculates or estimates an historical series in a different way than it originally was, i.e. the R-CPI-U-RS is revised

Recalculated-revised: A revised series that recalculates it from the basic data, instead of estimating or extrapolating the difference with the original series through other means, i.e. the current R-CPI-URS is not all recalculated

Current purchases: Using data on purchases that are in the same time period and frequency that the prices are taken from, i.e. when June '02 prices are used, so are June '02 shares and/or quantities, and July '02 prices are used with July '02 shares and/or quantities

Time range: A range of periods that form part of a series, i.e. a series could be indexed from January 1978 to Dec. 2019 using one index for the time range of Jan. 1978 to Dec. 1999 and another for the time range of Jan. 2000 to Dec. 2019

Examples

Consider the U.S. Census using this to decide the index to deflate historic median nominal household income to yield real median household income. Starting at the top left orange box, "Is the target of inflation 'all items' or relative to all items?" Since income is spent on all items, the answer would be "Yes." Next, "Is the target population a demographic subpopulation?" might answer "Yes" for households at or near the median, but since this isn't one the three subpopulation boxes, it would return a dead end and require restarting and going down the "No" line. Then "Is a monthly real-time never-revised index needed?" would answer "No". "Is the focus on output or consumer welfare?" answers "Consumer Welfare", leading to "Use the C-CPI-U" in a possible ending purple box. However, since the C-CPI-U is not available before 2000, the user would restart the process for the pre-2000 time range excluding the C-CPI-U box and changing course at the last orange decision box. The same process would then lead to the "Use of PCE index", but since the PCE index isn't available before 1959, the process would be restarted for the pre-1959 time range. This time the user would have to back up to the "real time" question box and change course leading to "Use the CPI-U". If an index was made that targeted households, the final checklist box would be "Yes", so if the desired answer to "Is the target population a demographic subpopulation?" was "Yes", then the newly made median income index would be chosen.

Suppose the C-CPI-U is later extended back in time, using the R-CPI-U-RS components, so that that a continuous C-CPI-U is available from 1978 onwards. Then the user would go to the first box on the bottom row, "Is a previously more preferable choice newly available for the time range?" In this hypothetical, the answer is yes for 1978-2000, so the user would replace the PCE index with the extended C-CPI-U series (the C-CPI-U-RS) from 1978-2000. The next box, "Is there a version with current purchases available?" would also answer yes but it is the same hypothetical new index. Next the "Is there a version of the current index with recalculated-revised indexes available?" box would answer yes assuming the C-CPI-U-RS used in the hypothetical new index was recalculated. Finally, assess the box "If the target is the cost of living of median income households, is there a version that also target the median income level itself?" The target does match, but the answer for this hypothetical would be "No." (Assuming the C-CPI-U-RS was for the population as a whole just as the C-CPI-U is.)

Now consider the choice of index for deflating the Official Poverty Measure (OPM). "Is the target of inflation 'all items' or relative to all items?" The second box, "Is the target population a demographic

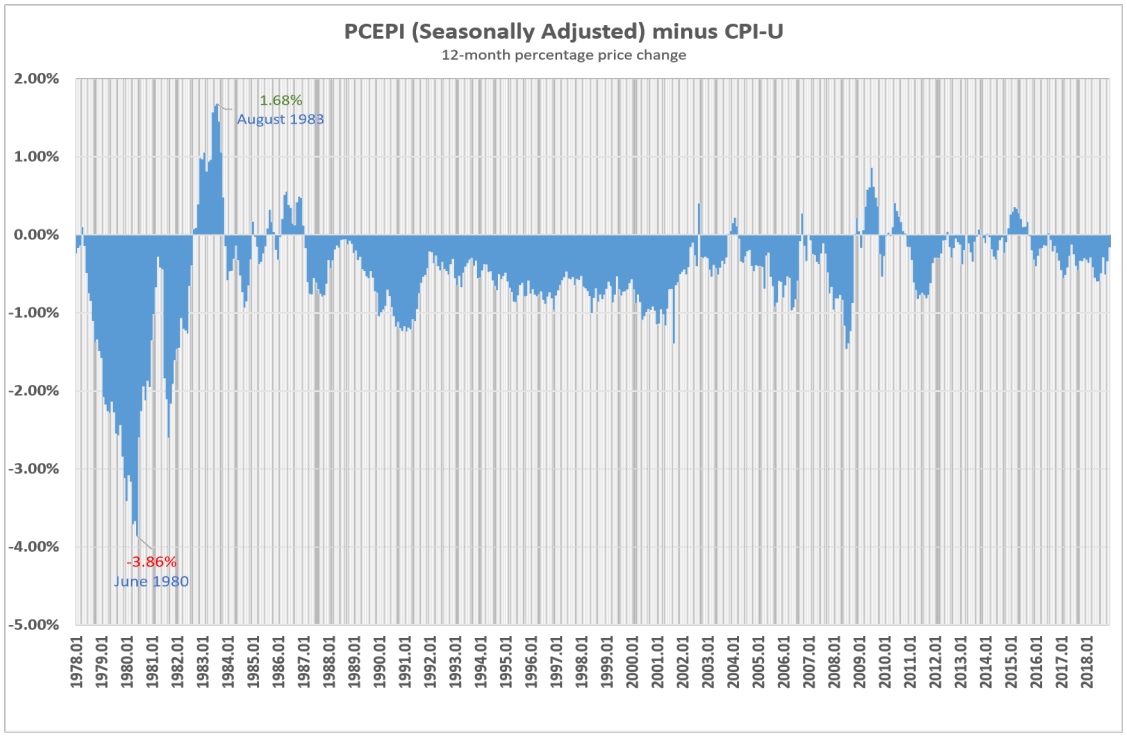
subpopulation" would answer "Yes," and direct along the "Poverty/low income" line to "Use the CCPI-P If available" box.

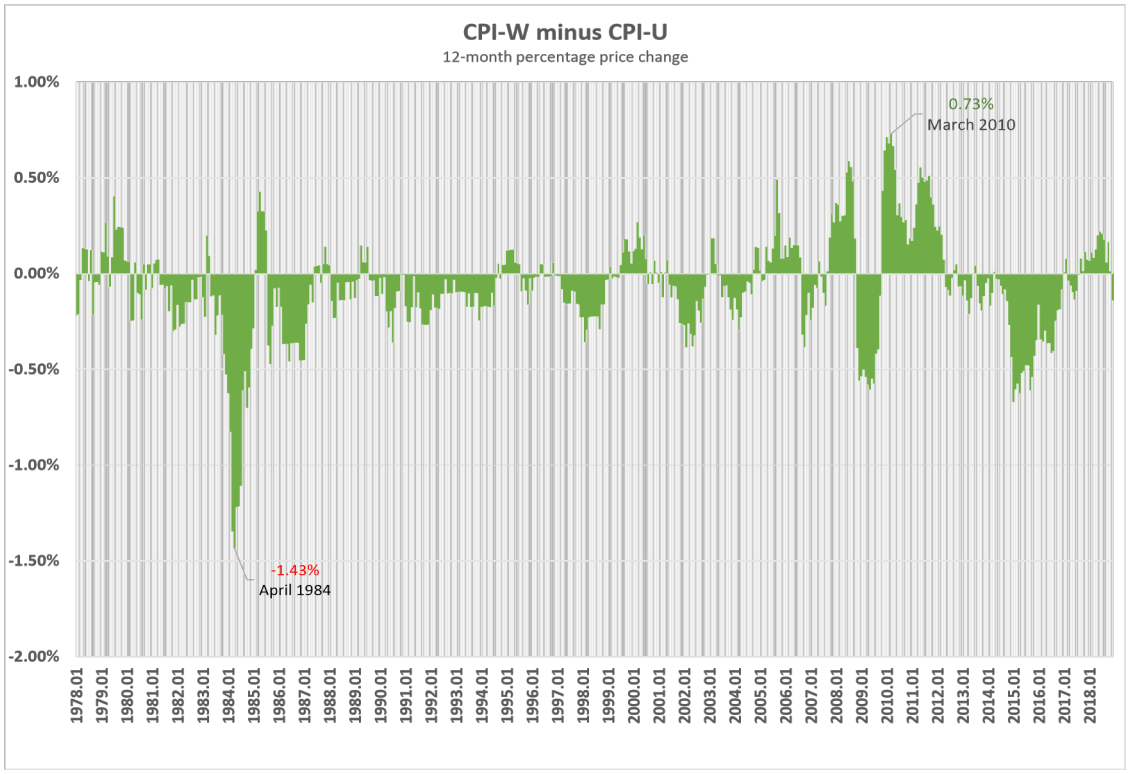
Next, consider the choice of index to escalate postal rates for mailing services. "Is the target of inflation 'all items' or relative to all items?" The target postal rates would be examined *relative* to all items, so "Yes" leads to the next orange box on subpopulations which would answer "No", the "Is a monthly real-time never-revised index needed?" would answer "No." "Is the focus on output or consumer welfare?" answers "Consumer Welfare," leading to "Use the C-CPI-U."

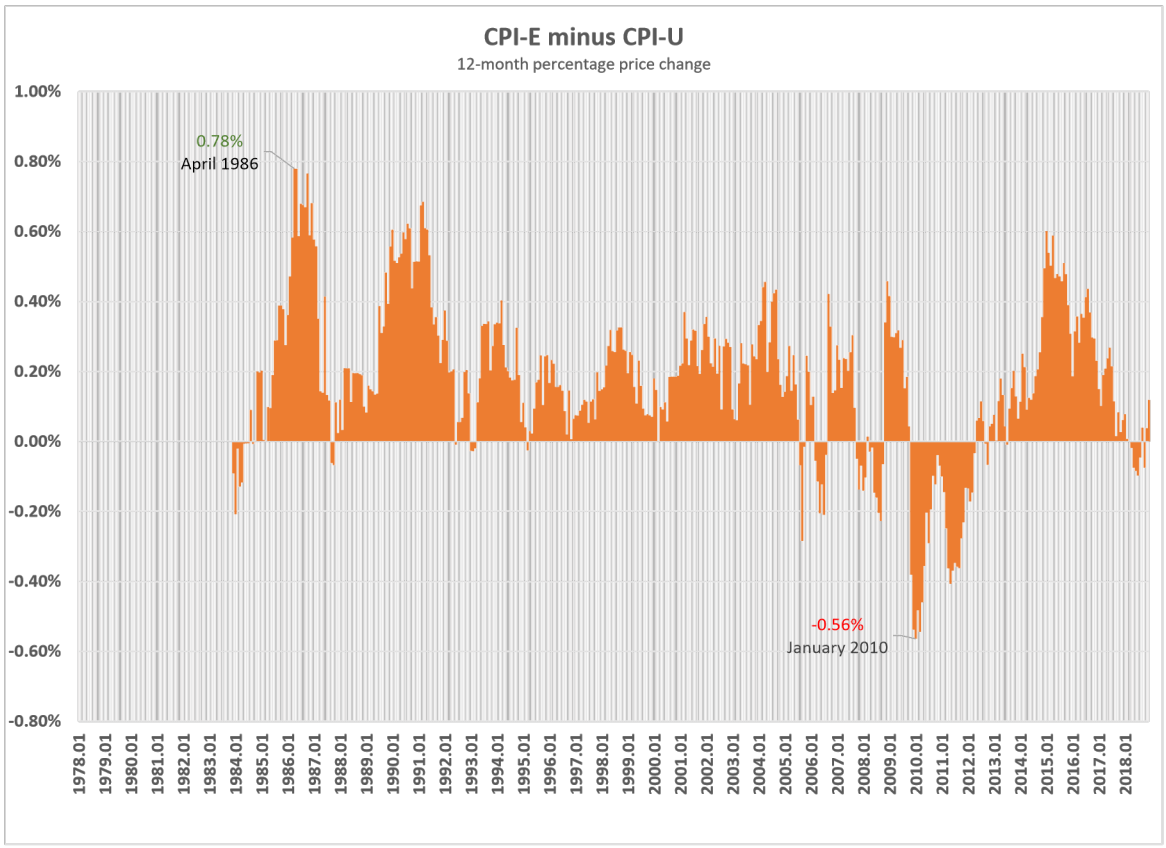
Finally, consider the choice of index for Treasury Inflation-Protected Securities (TIPS). The subpopulation box would answer "No", the real time question would (likely) answer "Yes", the official index question would (likely) answer "No", and so the purple "Use the initial (unrevised) C-CPI-U" would be chosen. With new indexes, since this is the first choice the first appendix box would answer "No", the next two would yield the same choice, and the last box would answer "No".

Appendix B

Appendix B.1: Consumer Price Index for All Urban Consumers (CPI-U) compared to other index measures






CPI-E minus CPI-U
12-month percentage price change
1.00%
0.80%
0.60%
0.40%
0.20%
0.00%
-0.20%
-0.40%
-0.60%
-0.80%
0.78%
April 1986
-0.56%
January 2010
1978.01
1979.01
1980.01
1981.01
1982.01
1983.01
1984.01
1985.01
1986.01
1987.01
1988.01
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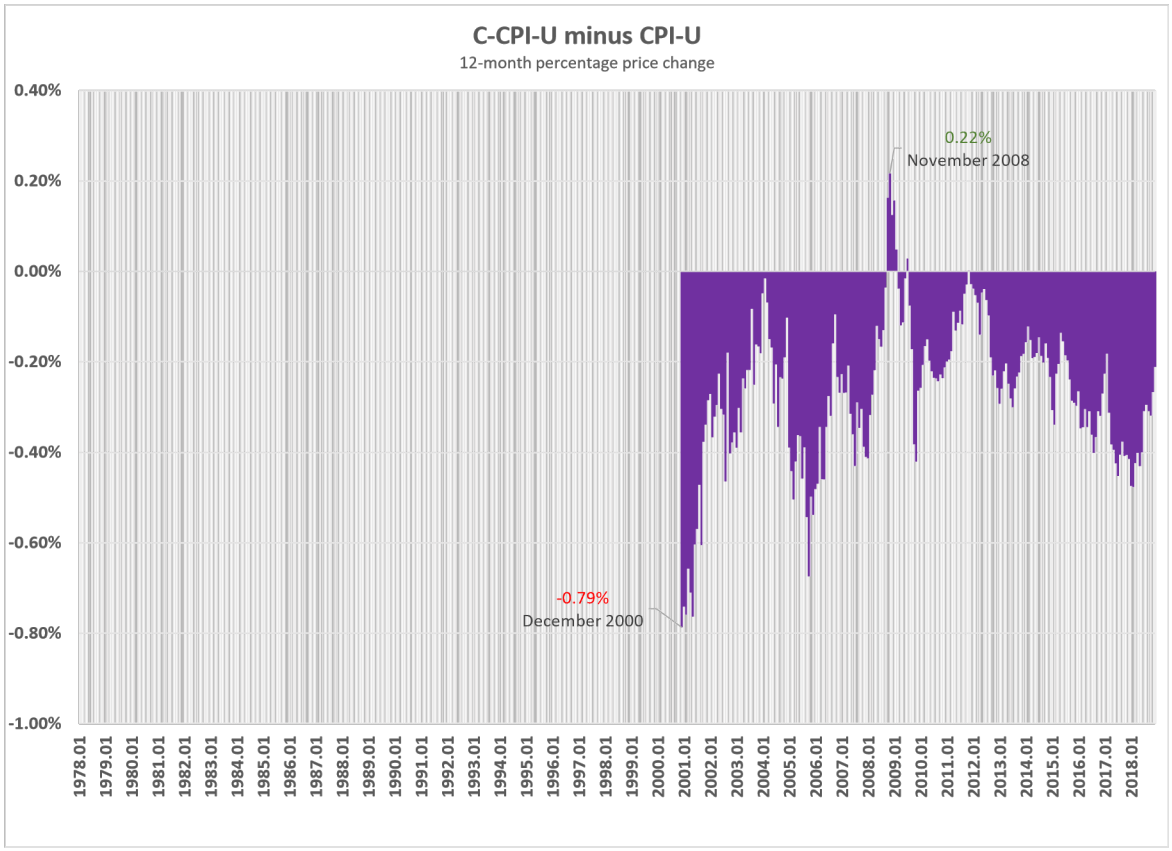
2018.01


C-CPI-U minus CPI-U
12-month percentage price change
0.40%
0.20%
0.00%
-0.20%
-0.40%
-0.60%
-0.80%
-1.00%
0.22%
November 2008
-0.79%
December 2000
1978.01
1979.01
1980.01
1981.01
1982.01
1983.01
1984.01
1985.01
1986.01
1987.01
1988.01
1989.01
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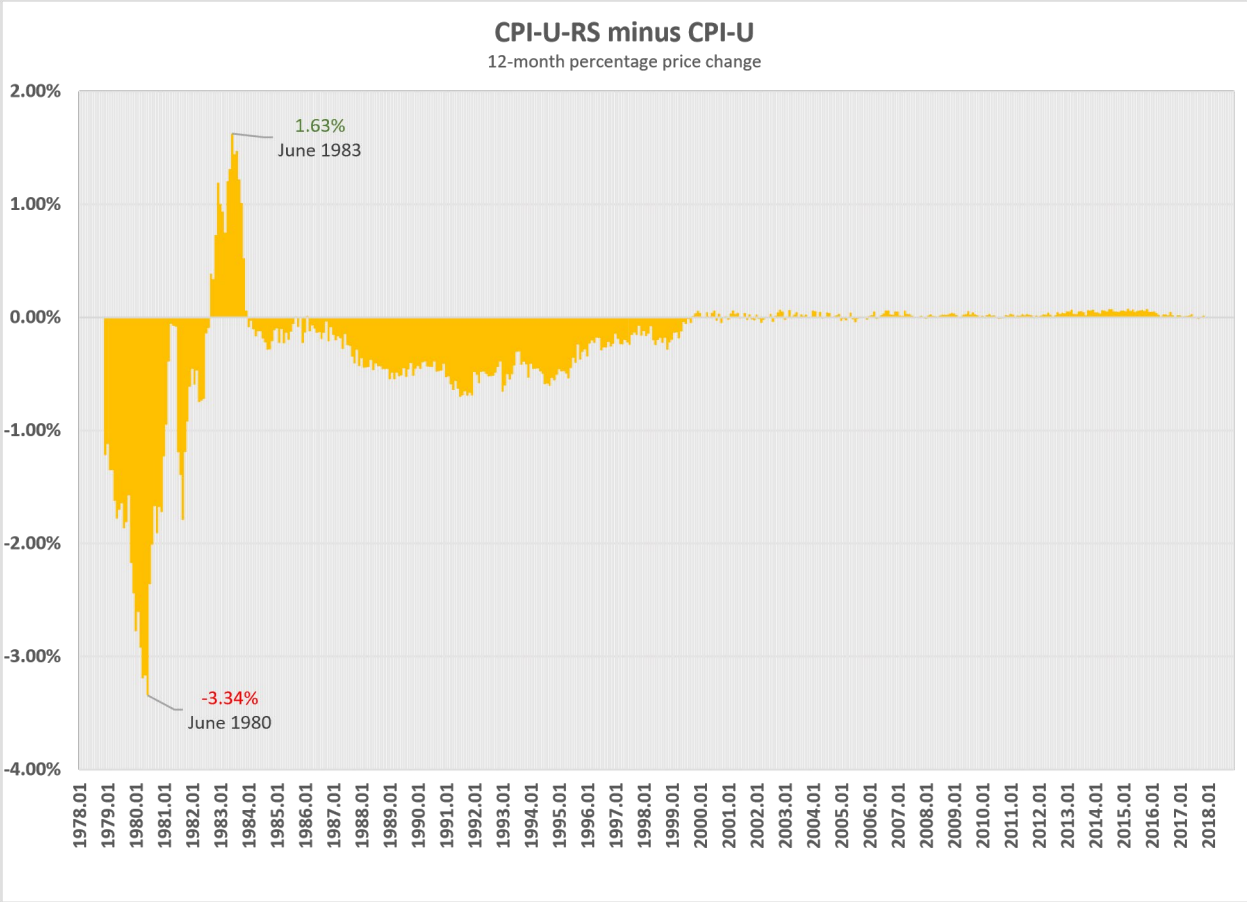
2018.01



Statistic	PCEPA (SA)	Chained CPI-U	CPI-U-RS	CPI-W	CPI-E
Mean	**-0.31%**	**-0.27%**	**0.02%**	**-0.02%**	**0.12%**
Standard Error	0.000262564	0.000110372	1.80227E-05	0.000197657	0.000157829
Median	-0.29%	-0.26%	0.02%	-0.04%	0.15%
Mode	-0.16%	-0.34%	0.05%	0.01%	-0.07%
Standard Deviation	0.0038678	0.0016259	0.0002580	0.0029117	0.0023250
Sample Variance	0.0000150	0.0000026	0.0000001	0.0000085	0.0000054
Kurtosis	0.576	1.257	-0.457	-0.019	0.197
Skewness	-0.234	-0.374	-0.109	0.166	-0.628
Range	2.32%	1.00%	0.12%	1.40%	1.17%
Minimum	-1.46%	-0.79%	-0.05%	-0.67%	-0.56%
Maximum	0.86%	0.22%	0.07%	0.73%	0.60%
Sum	-0.66204	-0.58135	0.04714	-0.04972	0.255387
Count	217	217	205	217	217
Confidence Level(95.0%)	0.00051752	0.00021755	0.00003553	0.00038958	0.00031108

Statistic	PCEPA (SA)	Chained CPI-U	CPI-U-RS	CPI-W	CPI-E
Number of periods smaller	175	210	39	121	61
Percentage of time smaller	**81%**	**97%**	**19%**	**56%**	**28%**

Appendix B.2: Poverty thresholds, family of four with two children, estimated using various indexes, anchor year=2000

YEAR	CPI-U	CPI-W	CPI-E	Chained CPI-U
2000	$ 17,463	$ 17,463	$ 17,463	$ 17,463
2001	$ 17,960	$ 17,939	$ 18,003	$ 17,857
2002	$ 18,244	$ 18,187	$ 18,335	$ 18,079
2003	$ 18,660	$ 18,590	$ 18,784	$ 18,456
2004	$ 19,157	$ 19,076	$ 19,347	$ 18,918
2005	$ 19,806	$ 19,748	$ 20,025	$ 19,466
2006	$ 20,444	$ 20,379	$ 20,680	$ 20,031
2007	$ 21,027	$ 20,965	$ 21,300	$ 20,537
2008	$ 21,834	$ 21,821	$ 22,113	$ 21,304
2009	$ 21,756	$ 21,674	$ 22,065	$ 21,204
2010	$ 22,113	$ 22,123	$ 22,365	$ 21,506
2011	$ 22,811	$ 22,909	$ 23,009	$ 22,163
2012	$ 23,283	$ 23,390	$ 23,482	$ 22,595
2013	$ 23,624	$ 23,710	$ 23,849	$ 22,872
2014	$ 24,008	$ 24,067	$ 24,287	$ 23,203
2015	$ 24,036	$ 23,967	$ 24,433	$ 23,175
2016	$ 24,339	$ 24,202	$ 24,820	$ 23,391
2017	$ 24,858	$ 24,716	$ 25,384	$ 23,804
2018	$ 25,465	$ 25,346	$ 26,001	$ 24,300
Total Change	**45.8%**	**45.1%**	**48.9%**	**39.2%**
Per annum change	***2.12%***	***2.09%***	***2.24%***	***1.85%***

Appendix B.3: Evaluation of CPI-P and Chained CPI-P

1. Study Period: December 1999 to December 2017

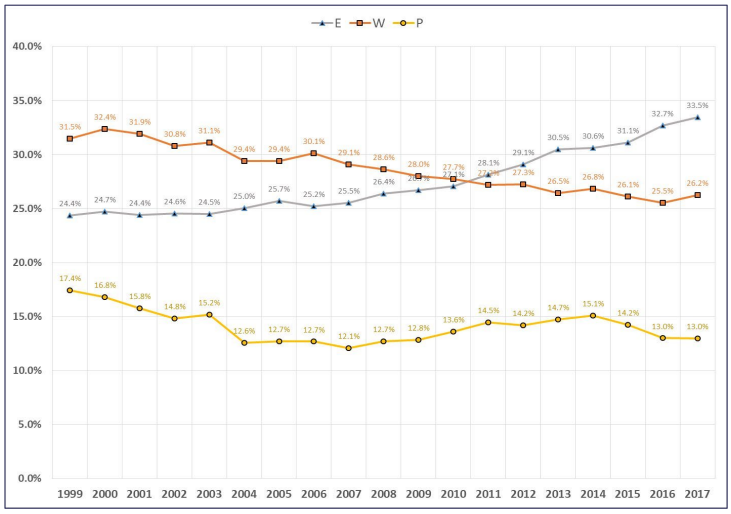
- Experimental indexes start with base period 2001.12=100

2. Expenditures: CE Diary and Interview Survey micro-level data, 1999 to 2017
   - Households classified into U, W, E, and P population groups
   - P=1 (Poverty household) if final income before taxes is less than official poverty threshold for corresponding calendar year; weighted average thresholds used by household size
   - Monthly weights for each cohort estimated for matrix of 210 items x 38 areas
3. Price Indexes: CPI elementary item-area indexes
   - Matrix of 210 items x 38 areas = 7,980 indexes each month
   - Adjustments made to build continuous matrix over entire study period:
   - HC09 (OER of vacation homes) mapped to HBO2 (other lodging) and elementary index deleted
   - EDO1 (Local) and ED02 (Long distance) collapsed into ED04 (Landline telephone service
   - 2010 structure for Medicinal drugs imposed retrospectively to 1999 (MA01→MF01, MA09→MG09, MB01→MF02, MB02→MG01)
   - Health insurance categories collapsed into ME01, Me02, ME03, ME04 throughout
4. Research objective: produce experimental CPI indexes for a poverty cohort
   - H1: Test hypothesis that inflation experience of a poverty cohort is higher than all consumer at large
   - H2: Test hypothesis that households in poverty exhibit fixed-quantity behavior (i.e., less substitution compared to all consumer at large

Sample Diagnostics

Population subgroup sample size, 1999 to 2017, CE-Interview Survey

as percent of CPI-U sample size



Average number of interviews per year

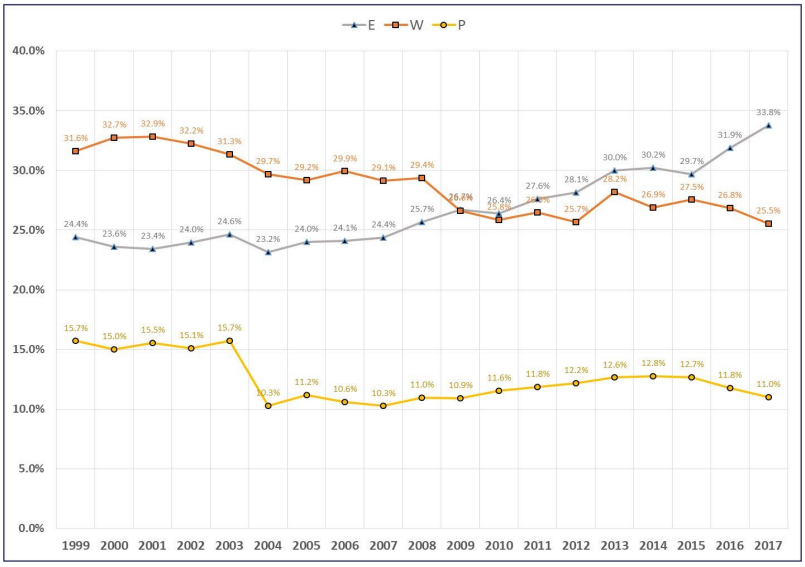
GROUP	Total	Per Basic Area	Per Basic Area per Quarter
U	26,501	697	174
W	7,641	201	50
E	7,204	190	47
P	3,743	99	25

KEY:
U = All urban consumers
W = Urban wage-earners and clerical workers

E = Elderly consumers (households with reference person or spouse 62 or over)
P = Households at or below official poverty thresholds

Population subgroup sample size, 1999 to 2017, CE-Diary Survey

as percent of CPI-U sample size



GROUP	Total	Per Basic Area	Per Basic Area per Quarter
U	12,985	342	85
W	3,759	99	25
E	3,426	90	23
P	1,631	43	11

KEY:
U = All urban consumers

Average number of diaries per year

E = Elderly consumers (households with reference person or spouse 62 or over)
P = Households at or below official poverty thresholds

W = Urban wage-earners and clerical workers

Percent of elementary cells with no expenditure data

n = 210 items x 38 areas = 7,980 cells per month
t = 12 months x 19 years = 228 months n x t =
1,819,440 total item-area-month cells

CATEGORY	U	W	E	P
Item-area-month	17.5%	41.3%	45.2%	63.4%
Item-area-month ratio allocated[1]	2.7%	9.0%	12.1%	24.0%
Item-U.S.-month (47,880 cells)	0.6%	1.4%	2.2%	4.5%
Item-area-biennial[2]	1.4%	4.8%	6.9%	13.7%

KEY:

U = All urban consumers

W = Urban wage-earners and clerical workers

E = Elderly consumers (households with reference person or spouse 62 or over)

P = Households at or below official poverty thresholds

NOTES:

1. Statistical smoothing procedure used in Chained CPI-U weights.
2. Level of aggregation for CPI-U basic weights, prior to statistical smoothing.

Expenditure Categories (EC) with the least and most missing data

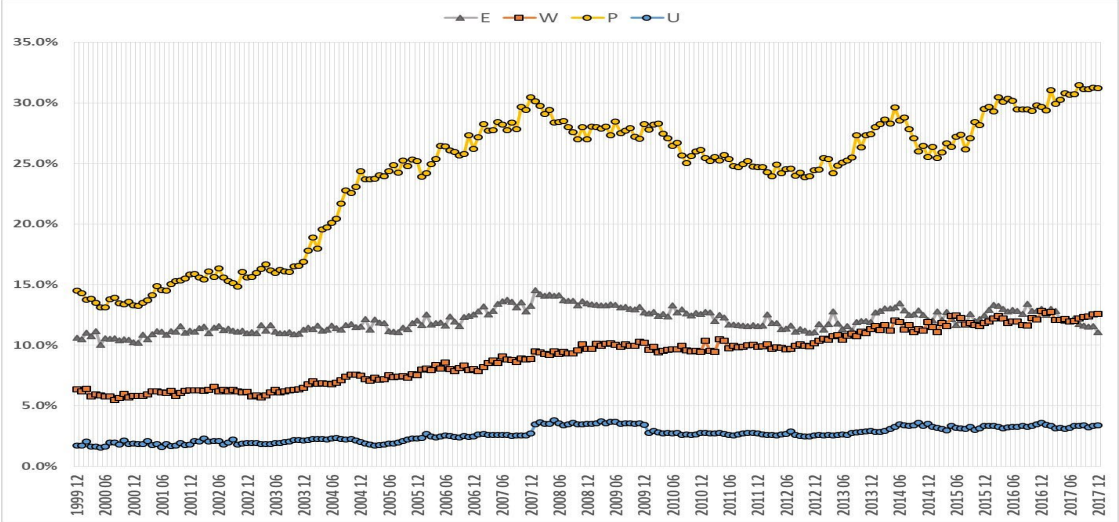
percent of ec-area-month cells with missing data

CPI-Poverty cohort

	Group	Title	% Missing
1	ED	Telephone services	0.0%
2	HF	Gas and electricity	0.2%
3	TB	Gasoline	0.3%
4	HA	Rent	0.3%
5	RA	Video and audio	0.3%
6	MF	Medicinal drugs	1.4%
7	GD	Miscellaneous services (laundry)	1.8%
8	MC	Medical services	1.9%
9	GC	Haircuts and personal services	2.0%
10	MD	Hospital services	2.9%
11	HC	Owner's rent	3.5%
12	ME	Health insurance	6.5%
13	EE	Internet and computer	6.8%
14	GA	Tobacco	6.9%
15	RF	Recreation services	8.0%

	Group	Title	% Missing
55	FP	Coffee, tea	10.8%
56	HJ	Furniture and bedding	11.1%
57	AC	Women's apparel	15.9%
58	AF	Infants apparel	16.0%
59	FG	Fish and seafood	16.7%
60	EA	Educational books	17.3%
61	AA	Men's apparel	20.3%
62	AG	Jewelry and watches	22.1%
63	HE	Fuel oil	28.9%
64	GE	Misc. personal goods	29.8%
66	AE	Footwear	31.3%
67	FW	Alcohol home	34.8%
68	RC	Sporting goods	36.0%
69	EC	Postage	36.1%
70	FX	Alcohol away	37.2%

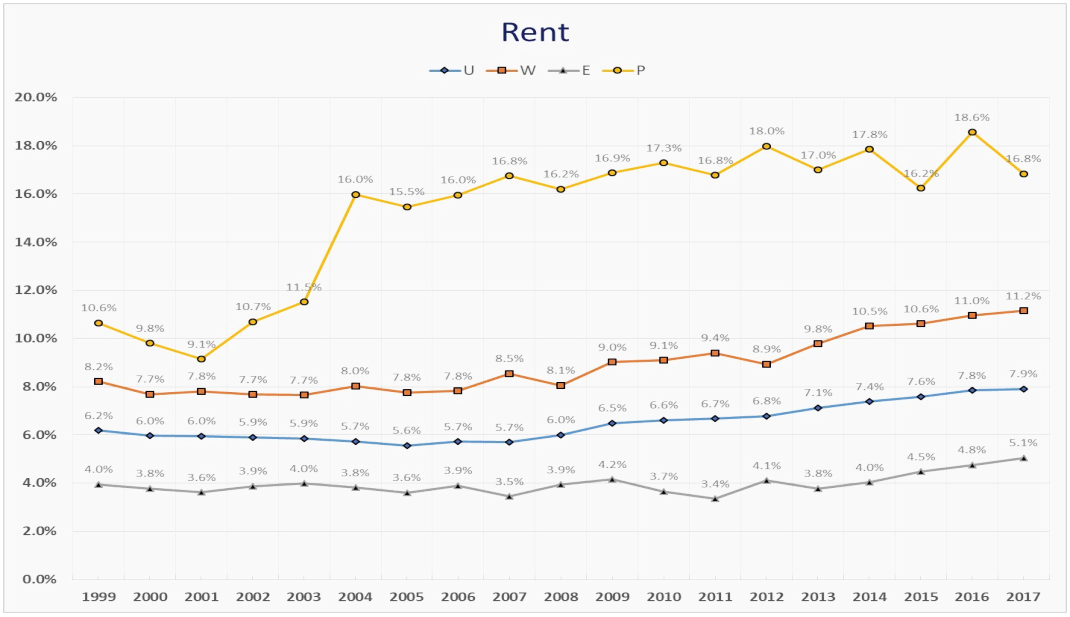
Percent of elementary item-area-months cells with expenditure < $1 after ratio allocation 1999.12 to 2017.12



KEY:

U = All urban consumers
W = Urban wage-earners and clerical workers
E = Elderly consumers (households with reference person or spouse 62 or over)
P = Households at or below official poverty thresholds

Relative importance, 1999 to 2017



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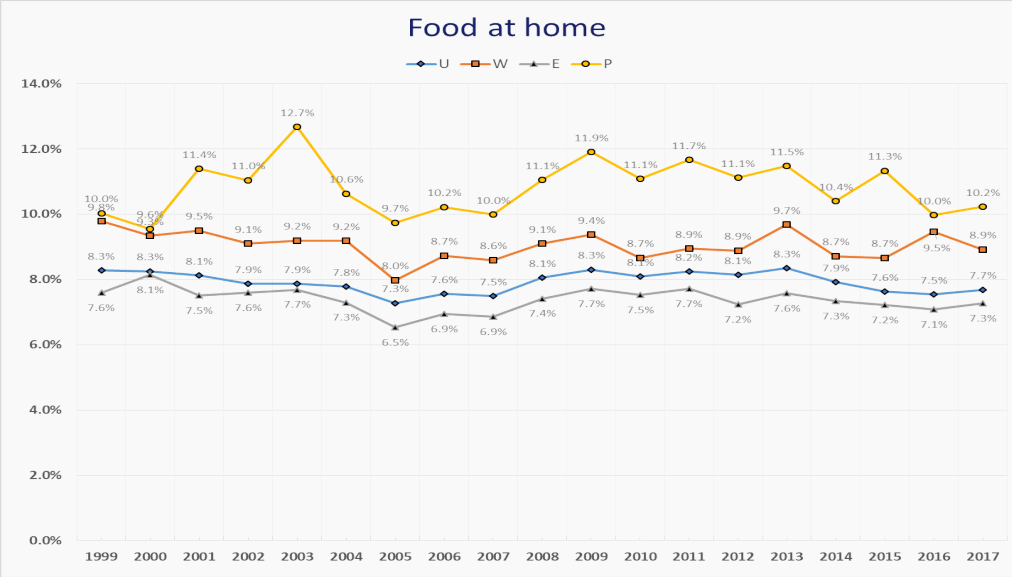
Relative importance, 1999 to 2017



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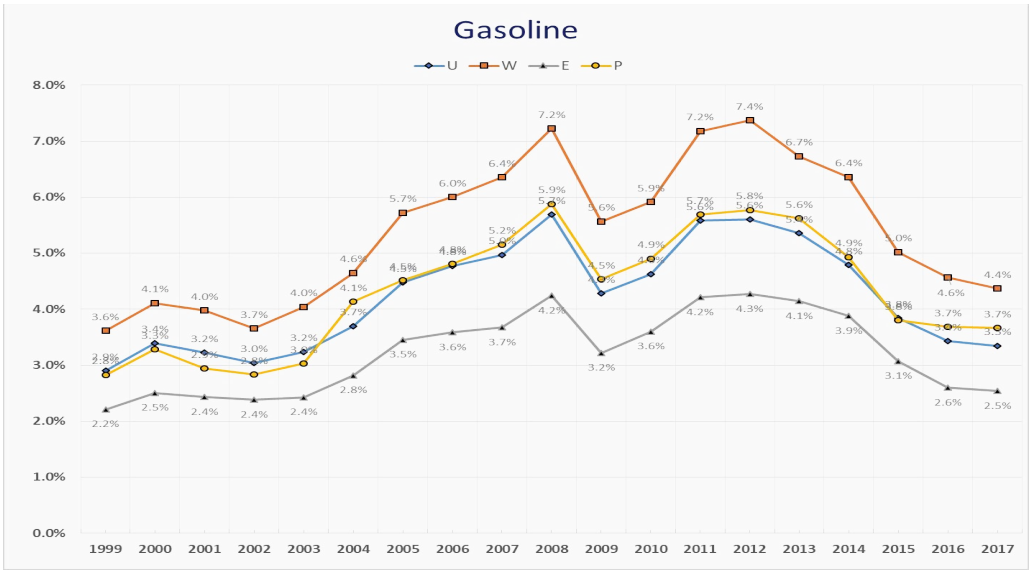
P = Households at or below official poverty thresholds

Relative importance, 1999 to 2017



KEY:

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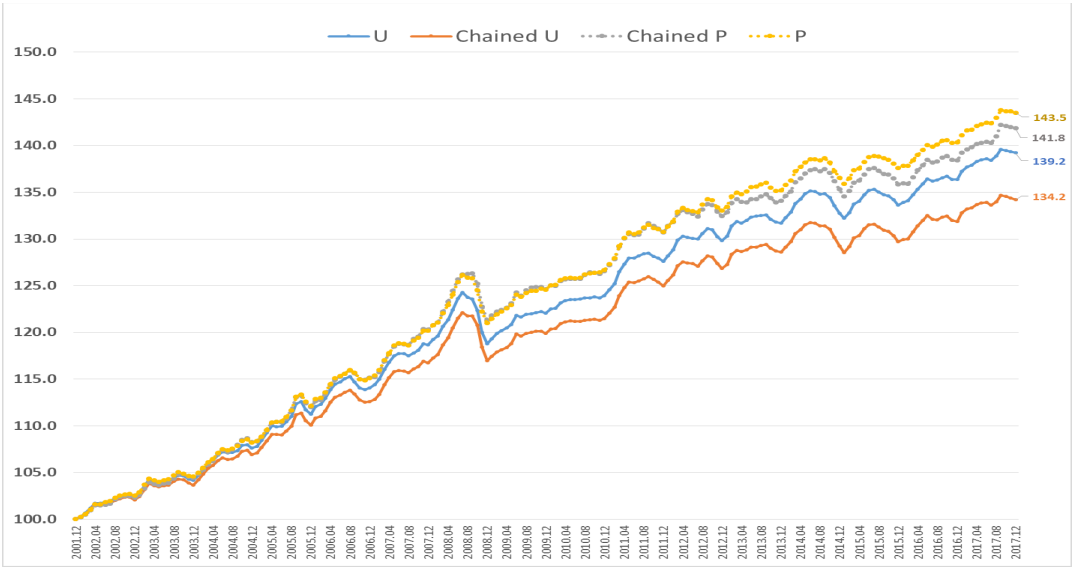
W = Urban wage-earners and clerical workers
E = Elderly consumers (households with reference person or spouse 62 or over)
P = Households at or below official poverty thresholds

Index Simulations

Summary

Historical index estimates, December 2001=100



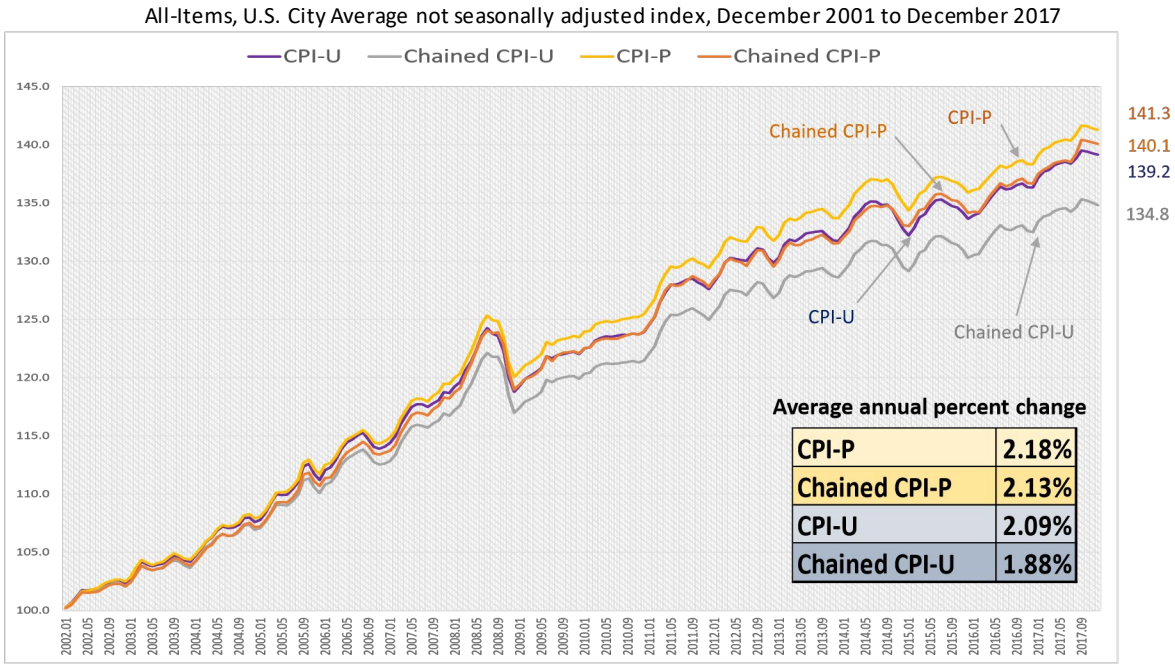
KEY:

U = All urban consumers
W = Urban wage-earners and clerical workers
E = Elderly consumers (households with reference person or spouse 62 or over)
P = Households at or below official poverty thresholds

Experimental low-income index

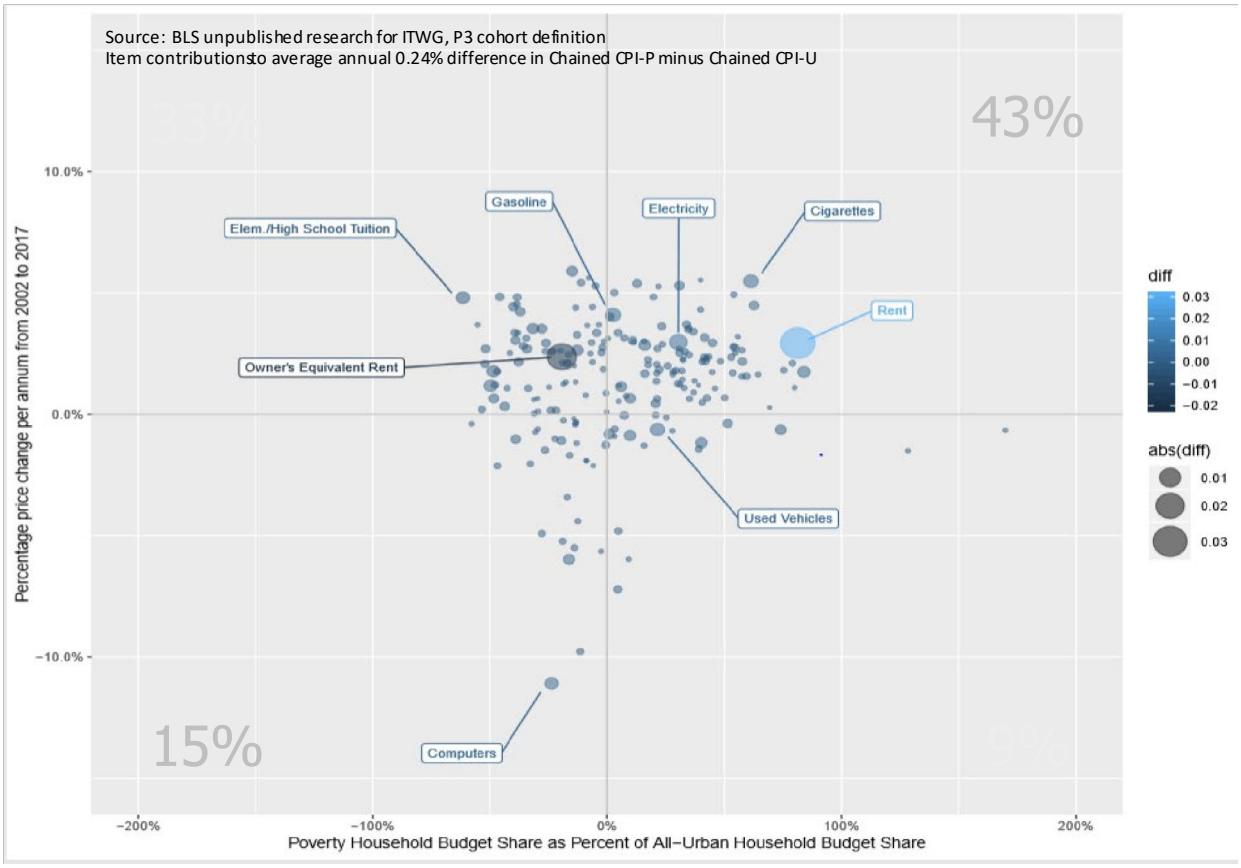
- ITWG developed spending weights for poverty households, using three different definitions
  - P1: All households with income less than or equal to OPM
  - P2: Lowest quartile of income
  - P3: 25% CE sample with mean income and minimum variance equal to OPM
- Weights used to calculate reweighted aggregations of CPI-U elementary item-area indexes
  - CPI-P simulations adopt same methodology as CPI-W and CPI-E
    - Exception: aggregation weights not statistically smoothed to minimize variance
  - Chained CPI-P simulations adopt same methodology as Chained CPI-U
  - Simulations do not control for heterogeneity in spending below the elementary item-area level
    - No control for specific outlets patronized by poor, unique products\services purchased, and actual transaction prices paid by poor

Experimental low-income compared to all-urban indexes



Source: BLS unpublished research for ITWG, P3 cohort definition

Chained CPI-P minus Chained CPI-U contributions



Appendix B.4: Breakdowns of index and share differences by item and poverty definition

This table reports the log differences by item in Tornqvist indexes and shares between different definitions of the poor and the whole population. It is sorted by the highest index difference between the income definition and the whole population to the lowest. The positive index contributions make the difference higher, while the negative contributions make the difference smaller. For example, the higher share on rent (HA01) vs. owner's equivalent rent (HC01) for the poor for the income definition leads to a large positive contribution to the difference for HA01 (at the top) and a large negative contribution for HC01 (at the bottom). The net of all of these is the total difference.

Appendix B.4: Breakdowns of index and share differences by item and poverty definition (XLSX)

Appendix B.5: Comparing subpopulation indexes to full population indexes and the studying the effects of sample size

In order to decide whether a subpopulation index was needed for the OPM, the group had to determine if the differences between the calculated subpopulation C-CPI-P indexes were due to the small CES sample sizes and the resultant higher variance of the indexes. To do this, various indexes were made by repeated resampling with replacement (bootstrapping) with different sample sizes. This yielded a distribution for each index, which was used to make means and confidence intervals to measure the effects of CES survey sampling. If the mean of the distribution was different from the non-bootstrapped index, it would imply that the sample size biased the index. If another index was outside of the 95% confidence interval of the distribution, then it was concluded that the difference was not due to variance from sampling or the small sample size. This method does not, however, include the variance due to price sampling, but the prices are the same for every index, only the CES respondent population is different.

Two kinds of sampling was done. First, the entire U population of the CES was sampled with replacement. This is to pick a sample that could have been chosen, using the actual sample as the universe to choose from. Then, depending on which definition of the P population was used, the subpopulation of the new sample was taken to make the new P index. This was repeated many times for each definition to get a distribution of chained P indexes, or C-CPI-P indexes, for each definition. Using more than 200 iterations was tested but made little difference. Since 12.5 % of the CES sample had reported income below the current official OPM, one definition was to use the bottom 12.5%, or $1/8^{th}$, of each new sample. Since the OPM itself is the true target, it could be approximated with equal numbers of CES respondents above and below the current OPM, which is about the bottom 25% of households by reported income, or the bottom $1/4^{th}$ of the new sample.

Due to time constraints, the programs calculating the indexes could not be made to exactly replicate the official indexes, as there are many structure changes and issues for particular items that make very small differences. Therefore, some of the small differences could be due to the simplified programs, but the scale of the differences between indexes is much larger than any replication errors.

Figure 1 shows the 95% confidence interval for the distribution for 200 resamples of C-CPI-P indexes using the bottom 25% of income definition, the mean of the distribution, and the full sample C-CPI-P for that definition and the C-CPI-U for comparison. The mean of the bootstrapped indexes is slightly below the full sample index, but the official C-CPI-U is well outside of the lower confidence interval bound. Thus, for this definition, the differences between the C-CPI-P and C-CPI-U are not due to the small sample size and sampling variation.

Figure 1

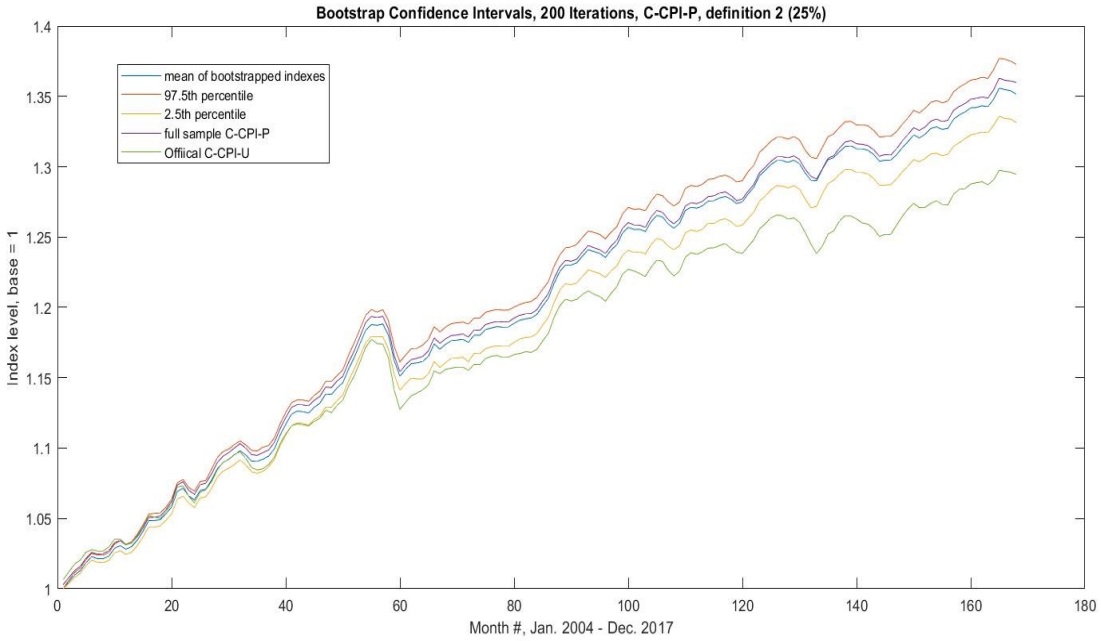


Figure 2 shows similar indexes above but instead uses the bottom 12.5% of income to define the P population. Here, the mean of the bootstrap samples is not below the full sample C-CPI-P. The confidence interval is wider than the 25% definition, but still excludes the C-CPI-U. **Figure 2**

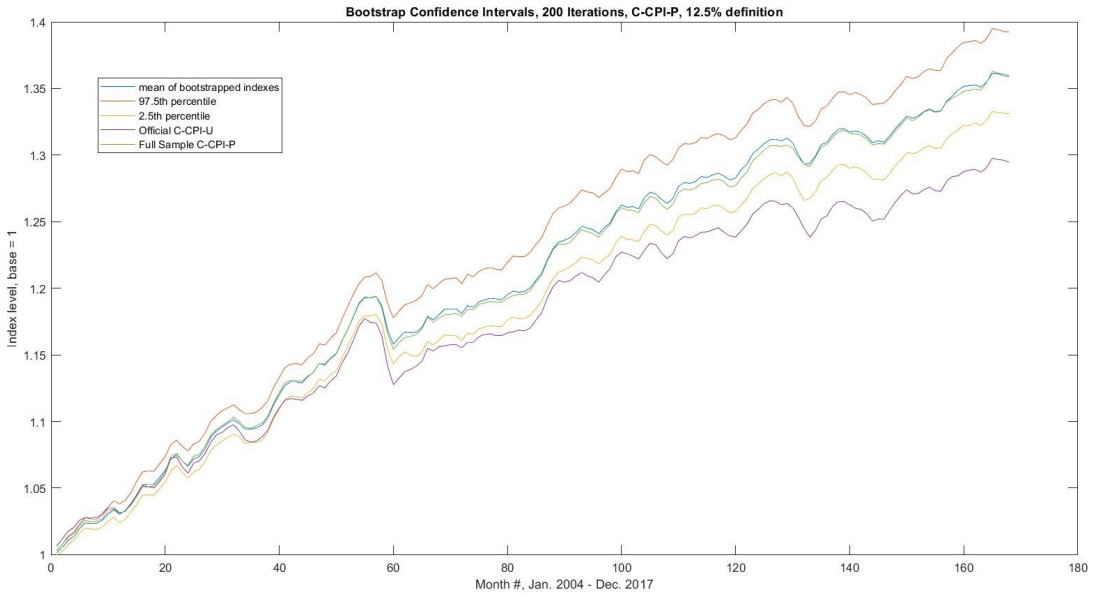


Figure 3 shows the mean and confidence intervals of the resampled distribution (700 iterations) of the while U population, but using only 25% of the sample size. This is to measure purely the effect of having a smaller sample size on the index. Also included is the C-CPI-P for the bottom 25% definition of the poor (P2). The mean is very close to the full sample index, the interval is tight, and the C-CPI-P2 index is outside of it.

Figure 3

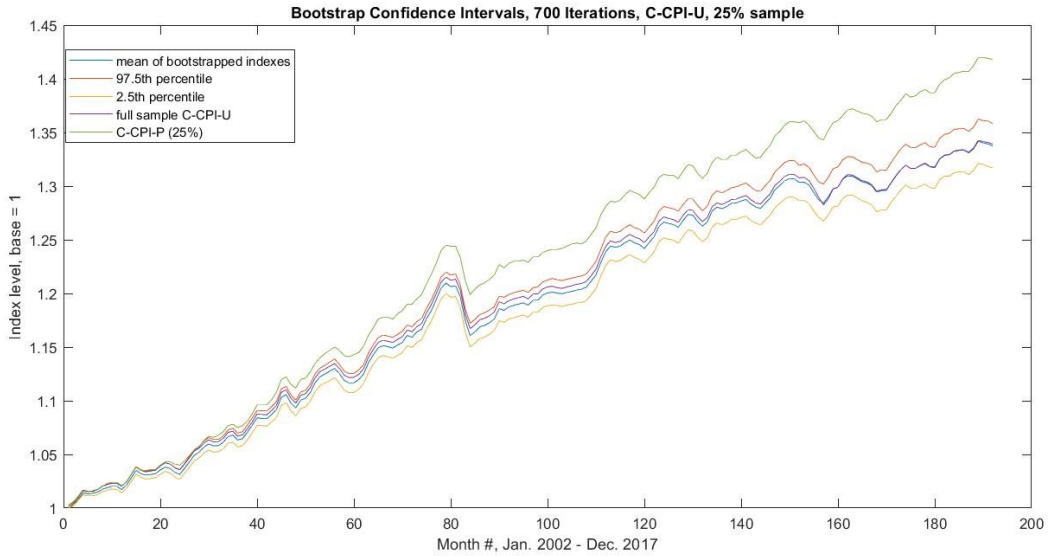
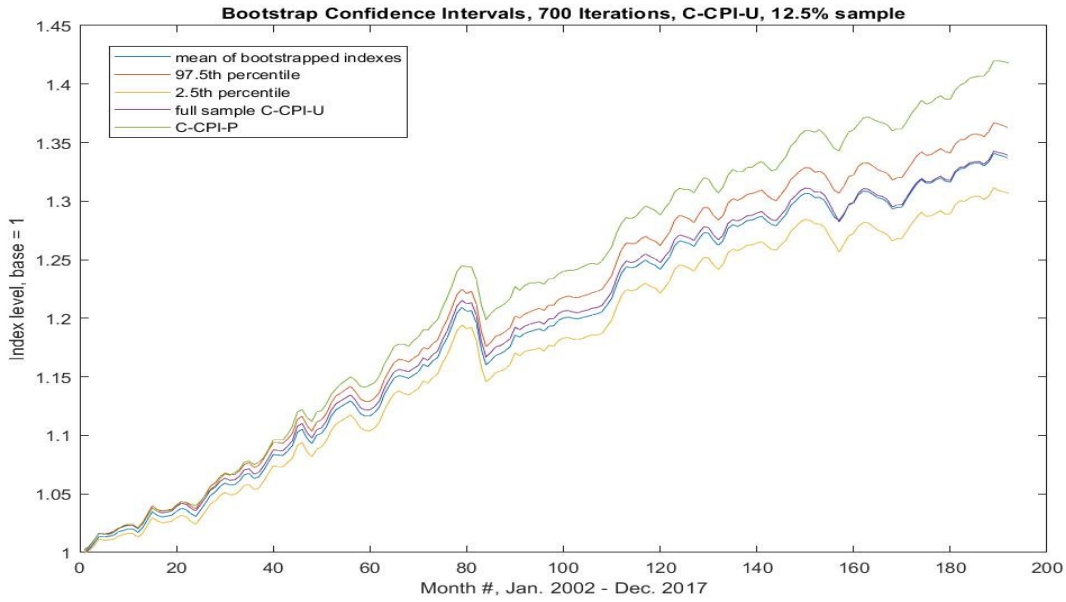
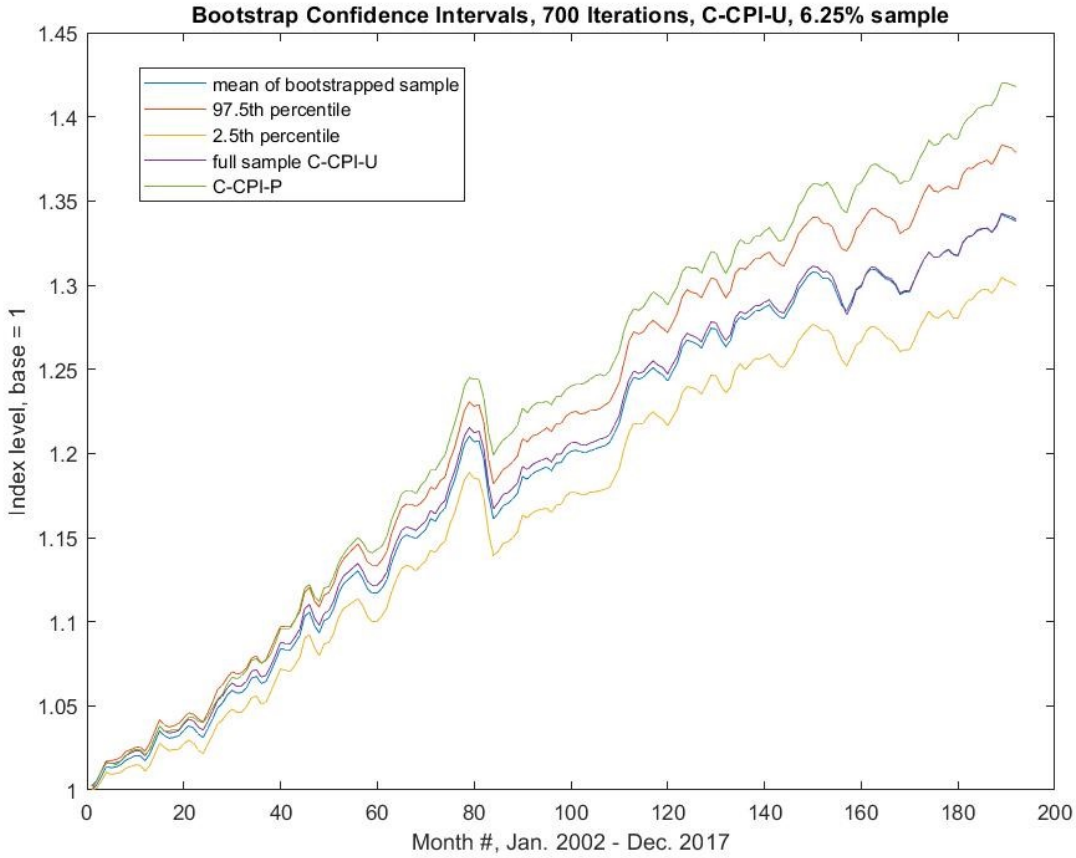


Figure 4 is similar, but uses a 12.5% sample of the U population. As before, the means are similar and the C-CPI-P is outside the interval, which is somewhat wider. **Figure 4**



To see how much the interval changes with an even smaller sample size, a 1/16th, or 6.25% sample of the U population was used, presented in Figure 5. Even though the interval is significantly wider than the 12.5% sample, the C-CPI-P is still outside of it. **Figure 5**



Appendix B.6: Analysis of Food Costs and Updated Multipliers

Research Questions: The ITWG calculated several different poverty thresholds based on the methods used to develop the Orshansky Poverty Thresholds in 1965. These thresholds were derived by dividing the cost of a nutritionally adequate short-term or emergency-use diet by the average percent of total household expenditures spent on food (see Background section below for more details on the Orshansky Poverty Thresholds). The OPM estimates current year thresholds from base year thresholds by using an inflation adjustment, while these methods generate new thresholds each year by using current data on food costs and expenditures.

(1) What would be the current value of a poverty threshold based on the Thrifty Food Plan with a fixed multiplier? (Updated TFP values are used, but the expenditure share multiplier is fixed at 3x)

o Results:

- For 2018, the TFP-based threshold with a fixed multiplier was **$23,115.** OPM higher than a TFP-based measure by 8.74%
- The TFP-based measure would have been above the OPM in 1973-1979

(2) What would be the poverty measure have been if based on the TFP with variable multiplier? (Updated TFP values are used, and the expenditure share is updated using the Consumer Expenditure Survey)

o Results

- For 2018, the TFP-based measure with changing expenditure share is **$63,410**
- TFP-based measure higher than the OPM by 249%.

Details on data and assumptions

- In 2018 the OPM was **$25,465** for a family of four with two children.
- Expenditure share drawn from CE when available o TFP was $642.10 per month in 2018
- CE Food Expenditure share was 12.2% (multiplier of 8.23) in 2018
- TFP measures based on Thrifty Food Plan Family of 4 - 2 children over 6 o Based on historical data from CNPP
- TFP from 1975 to present, EFP 1971-1974, Low-cost FP from 1960-1975 o No information on EFP (now TFP) from 1960-1970
- Use adjustment of data on Low-cost Food Plan: EFP is 80% of Low-Cost Food Plan

Background

The Four Current USDA Food Plans: The Thrifty, Low-Cost, Moderate-Cost, and Liberal Food Plans each represent a nutritious diet at a different cost[26].

- Revised by USDA's Center for Nutrition Policy and Promotion (CNPP), with assistance from USDA's Food and Nutrition Service (FNS), Economic Research Service (ERS), and Agricultural Research Service (ARS)
    - All four Food Plans are based on 2001-02 data and updated to current dollars by using the Consumer Price Index for specific food items.
    - There are 15 market baskets—one for each of 15 specific age-gender groups.
    - Child, Male, Female (each with 5 age ranges), Family of 2, Family of 4

The Thrifty Food Plan (TFP): The TFP provides a representative healthful and minimal cost meal plan that shows how a nutritious diet may be achieved with limited resources

- Assumes that all purchased food is consumed at home.
- The Thrifty Food Plan (TFP) market baskets specify the types and quantities of foods that people could purchase to be consumed at home to obtain a nutritious diet at a minimal cost.
- The TFP is the basis for SNAP (Supplemental Nutrition Assistance Program) allotments
- The Agriculture Improvement Act of 2018 calls for the foods that make up the basket for the TFP to be updated every five years and for purchase data to be collected from retail stores
- The TFP was last revised in 2006
    - Based on the 2005 Dietary Guidelines for Americans as well as the 2005 MyPyramid Food Guidance System.
    - Uses data from National Health and Nutrition Examination Survey (NHANES) and the Food Price Database to identify the prices low-income people paid for many foods.
    - Uses the 2001-2002 data on food consumption, nutrient content, and food prices.
    - Offers a more realistic reflection of the time available for food preparation, especially with increased expectations for work in assistance programs. o Allows more prepared foods and requires fewer preparations from scratch.

The Economy Food Plan: The 1961 Economy Food Plan (EFP) was developed by Mollie Orshansky of the SSA as a nutritionally adequate diet for short-term or emergency use.

- EFP was priced at less than the Low-Cost Plan and served as the basis for maximum food stamp allotments as stipulated in the 1964 Food Stamp Program Act.
- Replaced by the Thrifty Food Plan (TFP) in 1975.
- The EFP (now TFP) was not designed to be a minimum cost food plan but a palatable food plan at minimal cost that met the 1958 recommended dietary allowances.

[26] *https://www.fns.usda.gov/cnpp/usda-food-plans-cost-food-reports-monthly-reports*

- Designed for temporary or emergency use when funds are low.
- Included foods that require a considerable amount of home preparation.
- Required skill in food shopping and preparation, minimal food waste.

- The cost of the food plan was treated as an adequate standard of food expenditures for a household with income at the poverty threshold.

The EFP and the Orshansky Poverty Threshold: Orshansky used the EFP and 1955 Household Food Consumption Survey (USDA,1956) to develop a poverty threshold for income.

- The survey showed that for all households of two or more persons, the average dollar value of food used during a week accounted for one-third (1/3) of after-tax cash income
- These results were used to create a poverty threshold by multiplying the cost of the EFP by the inverse of the expenditure share (3) to calculate the poverty threshold of income.
  - The multiplier is based on a standard of adequacy for food and a food expenditure share, but not other necessities purchased by households.
  - Reasoning: no generally accepted standard of adequacy for essentials of living except for food at that time.
  - Expenditures shares vary by income: Low-income families spent 47% and high-income families spent 28%. (1955 values)
  - Different income thresholds were also set using multipliers of 2.12 for low-income and 3.57 for high-income.
  - Decided it was reasonable to use average income for all families when estimating the food expenditure share of total income.

Subsequent Work on the Economy-Thrifty Food Plan:

- Updates to Food Plans 1983, 1999, and 2006 have maintained procedural consistency with the 1975 update.
- Consumption data and dietary standards for each revision were more up-to-date, and the model is made more complex.
- The cost equivalency is a key feature of all updates in that the cost of a new food plan is set equal to the cost of the previous food plan adjusted for inflation with a food plan price index. (See Hanson Review of Ag Econ, Fall 2008)
- The revised food plans change the mix of food groups in the food plan and the mix of items in a food group, which affect the food plan price index.
- Food plan costs are inflated by a price index derived from Bureau of Labor Statistics food prices.
- Costs of the TFP market baskets are updated monthly for each of the 15 age-gender groups.
  - Uses the monthly Consumer Price Indexes (CPIs) for specific food categories to update prices for the food categories of the TFP market baskets.
  - Each of the 29 food categories of the TFP has a corresponding CPI or set of corresponding CPIs that are applied to update the appropriate cost of the TFP food categories for the market basket for each age-gender group.

- For TFP food categories with more than one corresponding CPI, CNPP uses a weighted average of the appropriate CPIs.
- USDA-food-plans-cost-food-reports-monthly-reports

Research on household food consumption and the food expenditure shares

- USDA Household Food Consumption Surveys began to examine food intake, diet quality, and health, moving away from data on household food expenditures
- This highlights the value of the Consumer Expenditure Survey (CE) to examine the long-term trends in household food expenditure shares
  - Historical note: CE for 1960-1961 found a food expenditure share of 25% (multiplier of 4)
  - Orshansky chose to use the USDA survey with 33% share (multiplier of 3)
    More detailed checklist of foods used in a week in the questionnaire

- Trend in the food expenditure share of after-tax income based on CE
  - For all families: 21.9% in 1960 (multiplier of 4.57) and 12.2% in 2018 (multiplier of 8.23)
  - Lowest quintile 34.1% in 2017 (multiplier of 2.93) and highest quintile 8.7% in 2017 (multiplier of 11.43)
  - Lower food exp share ==> higher multiplier ==> higher poverty threshold
    - Larger share of nonfood necessities in low-income household budget

References

Carlson, A. M. Lino, W.Y. Juan, K. Hanson, P. P. Basiotis. Thrifty Food Plan, 2006. U.S. Department of Agriculture, Center for Nutrition and Food Policy, CNPP 19, April 2007.

Hanson, K. "Mollie Orshanky's Strategy to Poverty Measurement as a Relationship between Household Food Expenditures and Economy Food Plan." *Review of Agricultural Economics,* 30(5) Fall 2008, 57-580.

Figure ES-1. Thrifty Food Plan Methodology