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I thank the subcommittee for this opportunity to provide background on the family of consumer price indexes published by the Bureau of Labor Statistics (BLS). As you know, the Bureau of Labor Statistics produces some of the nation's most current and important economic statistics to help policymakers, businesses, and households make the best decisions for themselves and others. In addition to inflation measures, the subject of today's testimony, we produce the monthly civilian unemployment rate and payroll employment figures, productivity estimates, occupational projections, on-the-job injury rates, wage and benefits measures, and a vast array of other highly-used national and regional data.

I will begin with a brief history of the CPI, which is a Principal Federal Economic Indicator released monthly by BLS, focusing on the methodological issues and changes implemented in recent decades. I will follow that history with a description of the building blocks of the Consumer Price Index for all Urban Consumers (CPI-U). I then will highlight the relevant features and differences that exist between the CPI-U and the CPI for Urban Wage Earners and Clerical Workers (CPI-W), and the Experimental CPI for Americans 62 Years of Age and Older (CPI-E). I will follow with a discussion of the Chained CPI for all Urban Consumers (Chained CPI-U), which has been the subject of much interest lately.

The Chained CPI-U represents the latest stage in the development of our cost of living measures and improves on the CPI-U by accounting for how consumers substitute among goods when the price changes of

those goods vary. In addition, the Chained CPI-U has the advantage of being less susceptible to statistical bias from the sampling variability of price changes at the item/area level. Measuring changes in the cost of living would be easy if the array of products in the marketplace never evolved, prices all moved together throughout the nation, people never changed what they bought, and there was little variety among people or products. In our dynamic economy none of these things is true. So, the BLS uses price surveys, consumption expenditure surveys and special formulas to arrive at monthly estimates of changes in the cost of living. Over the past century, technology and research have allowed our methodology to advance considerably.

The CPI was initiated during World War I, when rapid increases in prices made such an index essential for calculating cost-of-living adjustments in wages. Periodic collection of prices was started and, in 1919, BLS began to publish separate indexes for 32 cities. Regular publication of a national index, the U.S. city average, began in 1921, and indexes were estimated back to 1913.

The CPI improvements introduced over the years have resulted from BLS research and experience, as well as from in-depth analyses and critiques by outsiders. Notably, the 1961 report of the Price Statistics Review Committee (sometimes called the "Stigler Committee") provided impetus for subsequent changes in many aspects of the CPI, including the statistical sampling of outlets and items, expansion of population coverage, use of "hedonic" methods to deal with quality changes in consumer durables, regular updating of CPI expenditure weights, and use of cost-of-living theory.

The decade of the 1990s saw a surge of research on CPI methods. Some of this research was reported in the December 1993 *Monthly Labor Review*, which was devoted to discussions by BLS economists of CPI methods and issues. In that volume, Ana Aizcorbe and Patrick Jackman compared aggregate indexes based on the CPI's Laspeyres formula to indexes employing "superlative" formulas for the period 1982 to 1991. In another article, Brent Moulton described a complex but important problem that became commonly known as "formula bias." The way the BLS was using the Laspeyres index formula in the calculation of basic CPI item/area indexes had the unintended effect of giving greater weight to price increases than to price decreases. By 1996, the BLS

had corrected that upward bias and had begun studying the geometric mean formula, which the Moulton article had shown is not vulnerable to formula bias.

In 1996, a report to the Senate Finance Committee by the Advisory Commission to Study the Consumer Price Index (the "Boskin Commission") included recommendations to adopt a geometric mean formula for basic CPI indexes as well as to use a superlative index formula for aggregating those basic indexes to higher geographic and item group levels. The Boskin Commission also recommended that the BLS establish a cost-of-living index as its objective in measuring consumer prices.

Between 1997 and 2000, we made several important improvements to the CPI. The President's FY 1998 budget funded the BLS to produce what became the Chained CPI-U, to be first published in 2002. In December 1998, the BLS announced that in 2002 it would begin updating CPI expenditure weights on a biennial schedule, to replace the previous practice of updating weights roughly once per decade. In 1999, the geometric mean formula was adopted for the calculation of most CPI basic indexes. Finally, throughout this period the use of hedonic quality adjustment was expanded to several additional components of the CPI, such as televisions.

More recently, a 2002 report by a National Research Council panel of the National Academy of Sciences made numerous recommendations, including that the planned Chained CPI-U should include a real-time advance estimate and that we continue and expand our development and testing of advanced quality-adjustment methods.

I will return to most of these methodological issues and changes in the remainder of my testimony. To start, let me clearly state that the measurement objective of the CPI is to approximate a cost of living index, or COLI. This means the monthly CPI is an estimate of the changes over time in the cost to consumers of maintaining the same standard of living.

The CPI-U seeks to measure the change in the cost of living by estimating the change in prices that consumers pay for a market basket of goods and services in urban areas of the U.S. The CPI-U basket is divided into 211 item categories. An example of an item category is Uncooked Beef Steaks, or what the Committee might think of as types of steak bought at a grocery store. We collect prices for thousands of goods across the 211 item

categories in 87 distinct urban areas, which results in 8,018 unique item/area "cells" that form the building blocks of the CPI-U. Each month about 450 BLS employees collect more than 83,000 prices from about 23,000 retail establishments in the 87 areas to provide the prices that we use to develop price indexes. With about 10 observations per item/area, price movements are necessarily measured with some sampling variability. Robert McClelland and Marshall Reinsdorf in 1999, Ralph Bradley in 2005, and others have found that sampling variability can cause a Laspeyres index like the CPI-U to overstate inflation when a geometric formula is used to estimate price growth at the item/area level. It turns out that in the Chained CPI-U, which uses a Törnqvist formula rather than a Laspeyres formula in Stage 2 (as defined below), this bias from sampling variability is effectively eliminated.

For any given item/area cell, such as steak in Chicago, we also calculate expenditure weights. These weights represent the shares of total consumer expenditures across all items and areas. The source of data for these weights is the BLS Consumer Expenditure (CE) Survey. The CE is a household survey consisting of quarterly interviews and weekly expenditure diaries. We use interview and diary data taken over two years to construct weights for each of the 8,018 item/area cells. For example, the current CPI-U weights represent average expenditures over the 2009-2010 period.

We collect prices at a sample of retail outlets—basing our sample on telephone interviews of consumers who identify where they shopped within each of our 87 geographic areas. All consumer goods and services are potentially eligible for pricing, as are the locations at which the items are purchased. These include brick and mortar locations as well as web sites. The BLS pricing survey provides field collectors with a list of item categories they will price at each retail outlet. When specific items are brought into the survey for pricing, we select them according to standard statistical practices.

The CPI seeks to collect the retail, transaction price paid by the consumer, including sales and excise taxes. When we bring an item into the survey for the first time, our field economist records information on the detailed characteristics of the item. The list of detailed characteristics ensures that we can identify the same exact

item when we collect prices in subsequent months. If the item's characteristics change, we determine (statistically) what proportion of an observed change in price is due to the change in the quality characteristics of the item and what proportion is pure price change. If an item disappears permanently, we follow statistical procedures for selecting the best substitute item to price.

Once we have collected prices and weights for each of our cells, we are ready to produce a CPI. There are two distinct stages to this process. I would like to note for the Committee that these stages are critical for understanding the similarities and differences among our family of indexes—the CPI-U, the CPI-W, the experimental CPI-E, and the Chained CPI-U. For the CPI-U for each cell, we calculate an average change in prices using one of two mathematical formulas. For a small number of cells, prices are averaged using a Laspeyres formula, which assumes that consumers do not make substitutions in their purchases of goods as prices for the goods change. For example, we assume that consumers do not substitute among different types of surgery as relative prices change. By contrast, prices for most item categories (such as Uncooked Ground Beef in San Diego) are averaged using a geometric mean formula. This formula assumes that consumers substitute, to some degree, among unique products within an item category. For example, price change can influence choices among different brands of ground beef, ground beef sold at different stores, and ground beef with different percentages of fat. This formula generally shows a lower rate of inflation than a Laspeyres formula does.

Once stage 1 is complete, we have calculated price indexes for each of the cells. For the CPI-U in stage 2, we use a Laspeyres formula to combine our indexes across items and areas to produce the national CPI-U. When we use this formula, we are assuming consumers do not substitute across items or across areas. That is, we assume that they do not adjust their relative purchases between steak and hamburger in Chicago as the relative prices of those two items change. Similarly, we assume that they do not substitute among types of steak between Chicago and San Diego (or between steaks in Chicago and hamburger in San Diego).

To summarize, in the CPI-U we use a formula that assumes some substitution behavior within most item/area cells in stage 1, but we use a formula that does not allow any substitution across item/areas in stage 2.

Let me now turn to the CPI-W and the experimental CPI-E. As a starting point, let me note that the formulas and prices used in stages 1 and 2 for the CPI-W and for the experimental CPI-E are exactly the same as for the CPI-U. Therefore the source of differences between these two indexes and the CPI-U arises from the other building blocks of the CPI.

The CPI-W aims to estimate the cost of living for wage and clerical households in urban areas. A household that receives more than 50 percent of its income from the earnings of household members in wage and clerical occupations (for example, mechanics and retail sales workers) is considered a wage and clerical household. Thus, the CPI-W does not cover, for example, households of professional and salaried workers, the self-employed, the unemployed, or retirees. In fact, prior to 1978, the weights in the CPI were confined to wage and clerical households. In 1978, the scope of the CPI was expanded to include all urban households; since then we have published both a CPI-U and a CPI-W. Over longer periods, the CPI-U and CPI-W tend to move in tandem; for example, over the 20 years ending in December 2012, both measures increased at an average annual rate of 2.4 percent. But they do not always line up, especially over shorter periods. For example, over the last 12 months, the CPI-U has increased 2.0 percent, while the CPI-W has increased 1.9 percent.

Any measured price changes between the CPI-U and the CPI-W stem from differences in the relative expenditures of the respective CPI-U and CPI-W populations. By construction, the CPI-W uses all of the prices that are used for the CPI-U. In other words, we use prices based on a data collection methodology that identifies where all urban consumers shop, the "basket" of items they buy, and where these urban consumers live. So the formulas and the prices used for the CPI-W are exactly the same as for the CPI-U. The difference between the CPI-U and the CPI-W reflects different expenditure weights used to aggregate the indexes for the 8,018 cells. The CPI-U uses 2 years of expenditure weights representing all urban consumers, based on approximately 76,000 interviews. The CPI-W uses the same two years of expenditure weights, but only those in wage and clerical households in the CE, who constitute about 31 percent of the CPI-U household sample.

Using CPI-U prices in the calculation of the CPI-W means that we assume that wage and clerical households shop in the same retail establishments, buy the same mix of specific items in those establishments, and live in the same neighborhoods as other urban consumers. That is, we do not have a separate data collection effort to identify these building blocks for wage and clerical households. Although these dimensions are undoubtedly somewhat different between all urban and wage and clerical households, we do not believe that these differences are significant enough to compromise the accuracy of the CPI-W.

What about the CPI-E? Like the CPI-W, the experimental CPI-E depends on the exact same formulas and prices as the CPI-U for stage 1 and stage 2, and then we apply different stage 2 weights. The CPI-E uses expenditure weights for households with a respondent or spouse 62 years of age or older. For 2009-2010, these weights are based on a sample only 26 percent as large as the entire CPI-U sample. Over the past 20 years, while the CPI-U and CPI-W increased at an average annual rate of 2.4 percent, the CPI-E has increased at an average annual rate of 2.6 percent. Again, for any period, divergences between the CPI-U, CPI-W, and CPI-E are solely the result of differences in the expenditure patterns of the respective populations. For example, older Americans tend to spend more on health care than urban consumers as a whole.

We call the CPI-E experimental in part because its expenditure weights are based on sample sizes that are smaller than those of the CPI-W. In addition, a key defining feature of the experimental CPI-E is that—unlike the situation for wage and clerical households—CPI-U prices may not be sufficient to represent those paid by the elderly population. We recognize that elderly households live in different places, shop at different retail outlets, buy a different mix of products, and even in many cases qualify for different prices than other urban consumers. Moving from an experimental to an official CPI-E would require researching and addressing these issues.

Finally, let me turn to the Chained CPI-U. We have produced this index since 2002, and have values for it back to December 1999. Continuing our previous discussion, the Chained CPI-U differs from the CPI-U, the CPI-W, and the experimental CPI-E in both the weights and formulas that we use. In addition, unlike these three latter indexes, the Chained CPI-U is subject to two revisions before it is final. To convey the nature of all of these

differences and the conceptual basis for the Chained CPI-U, it is easiest to begin by describing the "final" Chained CPI-U.

The Chained CPI-U uses the same stage 1 cell indexes as the CPI-U, CPI-W and experimental CPI-E. In the stage 2 aggregation of these indexes, however, the final Chained CPI-U uses what economists call a "superlative index" formula. In particular, it is a Törnqvist index, which is a member of the family of superlative indexes. A distinguishing feature of these indexes is that they are based on how actual spending patterns change as relative prices change. For example, to calculate the final Chained CPI-U rate of inflation between February 2013 and March 2013, we will use observed consumer expenditures for each of the cells in both months.

As an example of how the Chained CPI-U takes substitution into account, consider the impact of a hypothetical 10-percent gasoline price increase on a consumer who typically spends $80 on gasoline per week. A Laspeyres index, like the CPI-U, would estimate that the consumer's cost of living has increased by $8 per week. Rather than keep her weekly gasoline purchases constant, however, the consumer might decide to cut back somewhat on driving and shift some of the money she would otherwise spend on gasoline to other products, such as groceries. She might even decide to ride the bus sometimes instead of driving. In either case, the consumer would be deciding if she would be *better off* by shifting her spending pattern than by spending the entire $8 on gasoline. Put another way, the cost of keeping her standard of living constant has gone up by something *less than* $8 per week.

As our hypothetical consumer shifts her purchases relatively away from gasoline and toward bus fares, the Törnqvist index directly measures the greater expenditure weight on the item categories toward which consumers are shifting. In this example, these categories were food and public transportation, which by assumption increased in price by less than gasoline. Note that the reverse would be true if, for example, public transportation increased in price relative to gasoline, and consumers reacted by driving more and riding buses less. In that case, the Törnqvist formula would measure more weight on the gasoline index and less on the public

transportation index. Note also that if price changes were even across all items or consumers did not change their spending patterns, the CPI-U and Chained CPI-U would always be the same.

Because prices often do not change uniformly and consumers shift purchases in response, and because price changes are subject to sampling error, the measured rate of price change using the Chained CPI-U typically is lower than that of the CPI-U. In the 12 years from December 1999 through December 2011, the CPI-U grew at an average annual rate of 2.5 percent, while the Final Chained CPI-U increased at an average annual rate of 2.2 percent. The paper by Bradley referred to above suggested that just over half of the difference between the CPI-U and Chained CPI-U was due to sampling variability and the remainder was due to substitution among item categories. In a 2006 *Monthly Labor Review* paper, the authors summarized BLS research by saying that the sampling error effect "could yield an upward bias of 0.1 percentage point or more per year" in the CPI-U.

The BLS designed the Chained CPI-U to provide a closer approximation to a cost of living index than the CPI-U. However, operationally, it is important to note that the data on consumer expenditure weights for any period are only available with a significant lag. In the example of calculating the rate of inflation on a chained basis between February and March 2013, the complete weights for 2013 are not ready for use until the end of 2014, and final 2013 values for the Chained CPI-U will not be published until February 2015.

Given the lags for relevant monthly consumer expenditure weights, BLS provides an initial and then an interim value for each monthly Chained CPI-U index before producing the final value. To accomplish this, we use the same base-period expenditure weights as the CPI-U, but in a different formula. The initial and interim versions of the Chained CPI-U use the geometric mean in stage 2. This index assumes consumers substitute across the 211 market basket categories. BLS research in recent years has identified methods that have potential to improve the closeness of the initial and interim Chained CPI-U indexes to their eventual final values.

A question often raised is whether the BLS can produce a chained CPI for the elderly. We note that the reasons cited above that make the CPI-E an experimental index, namely the relatively small CE samples for elderly consumers and the lack of adjustment for differences in where the elderly shop, what they buy or the

prices they pay, would also apply to using monthly consumer expenditure weights to create chained CPI-E estimates. Thus, development of a non-experimental chained CPI-E index would have to begin with a thorough research effort.

To sum up, measuring changes in the cost of living in a dynamic economy can be complex and the BLS has created the Chained CPI-U to provide a cost of living measure that improves on the CPI-U by accounting for how consumers substitute among goods when price changes are uneven.

Thank you for the opportunity to testify before this committee. Dr. Horrigan and I are happy to answer any questions you may have.