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25-3 Modernizing Price Measurement and Evaluating Recent Critiques of the Consumer Price Index

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ABSTRACT

The consumer price index (CPI) plays a critical role in measuring inflation. Recent inflation trends, however, have raised questions about its accuracy. This paper evaluates several of these critiques, including that the CPI fails to keep up with rapid changes in consumer expenditure patterns; that its methodology is out of date; that the CPI does not correctly track the cost of housing; and that it does not keep up with rapidly changing products being purchased in the market. We also discuss the concern that, while year-over-year inflation has slowed dramatically since reaching its peak in June 2022, consumers still face considerably higher prices than before the pandemic. Drawing on insights from the *2022 CPI Modernization Report* (NASEM 2022), we argue that the basic CPI methodology is sound and that it provides a robust and defensible measure of inflation. However, as consumer markets and data environments evolve, updates to CPI methodologies are necessary. We underscore the need for continued investment in economic statistics to ensure the CPI remains a reliable gauge, benefiting policymakers, businesses, and consumers.

JEL Codes: E30, E31
Keywords: Consumer Price Index, CPI, inflation, prices, price measurement

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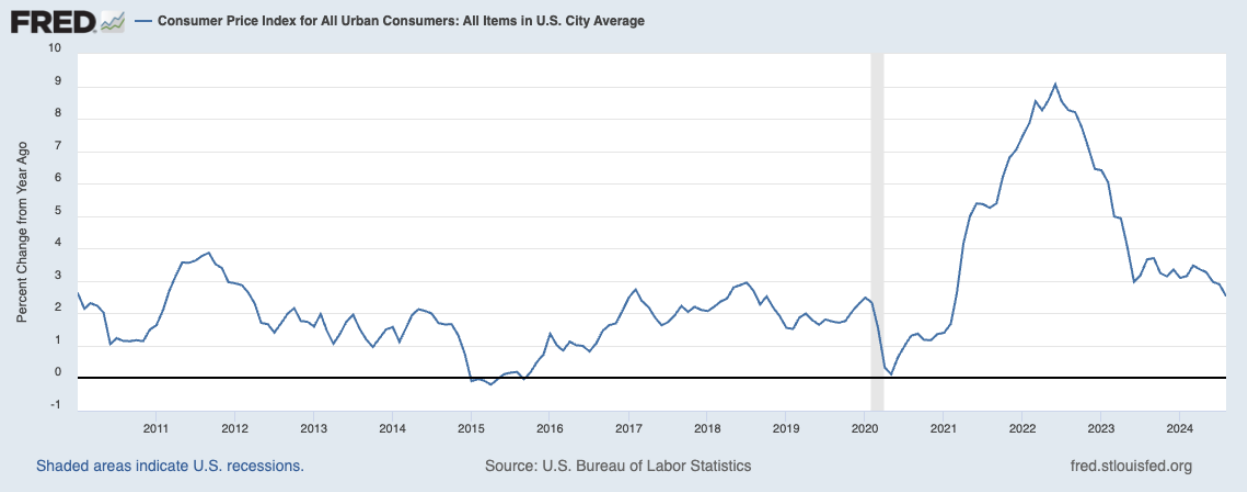
1. Introduction

Inflation has been front and center in the news and for households, businesses, financial market participants, and policymakers since it began surging in mid-2021, with the 12-month change in the consumer price index (CPI) hitting a peak just over 9 percent in June 2022 (figure 1). This acceleration had several underlying causes, including pandemic-related supply chain and labor market disruptions, the Russian invasion of Ukraine, which put upward pressure on energy and food prices, and demand that was bolstered by COVID-related stimulus. Since mid-2022, inflation has retreated quickly as supply chain disruptions resolved and the effects of tighter monetary policy worked their way through the economy.[1] While the inflation rate has eased substantially, the overall price level remains well above its pre-pandemic level, a significant pain point for many consumers.

Figure 1 CPI for all urban consumers (percent change from year earlier)



Source: Bureau of Labor Statistics (BLS) data as processed by the Federal Reserve Bank of St Louis.

As a consequence of the recent salience of inflation, questions have been raised about whether official measures are providing reliable gauges of inflation. Indeed, some commentators have suggested that inflation and prices are higher than official measures, while others have argued that inflation has fallen more than has been captured by published figures. For example, Paul Krugman in the *New York Times* highlighted commentators who discounted the amount of disinflation reported by the CPI and who suggested that actual inflation remained elevated (Krugman 2024). Among those arguing the counter position, the price of rents, and the cost of housing more broadly in the CPI, have come under special scrutiny given their big increases early in the COVID era, their large share of household budgets, and their sluggish return to the pre-COVID rate of increase. For example, Rachel Siegel argued in a *Washington Post* story (2024) that rent inflation had come down more than reported in the CPI.[2]

[1] See Bernanke and Blanchard (2023) for a discussion of the relative importance of different factors in contributing to the upswing in inflation.

[2] Data on asking prices suggest that, by that measure, rental price inflation peaked in late 2021 or early 2022 (Siegel 2024).

Of course, controversy surrounding the measurement of inflation is nothing new. During the earliest days of the CPI, labor and business interests argued over how much the cost of living was changing and what those changes should imply for wages, as carefully documented in Stapleford (2009). Within more recent memory, the mid-1990s were another high point in controversies surrounding inflation measurement. Alan Greenspan, then the chair of the Federal Reserve Board, suggested in congressional testimony in 1995 that the CPI was likely overstating inflation. Those comments led to the appointment of a panel, the so-called Boskin Commission, to investigate Greenspan's assertion. The Commission's influential report estimated that the CPI was overstating the true rate of increase in the cost of living by 1.1 percentage points per year, with new products and quality change accounting for the largest share of the bias, followed by consumer substitution of products in response to relative price changes (substitution bias) (Boskin et al. 1996). Given the widespread use of the CPI for indexing government programs—Social Security benefits (since 1972), parts of the federal tax system (since 1985), inflation-linked bonds (since 1997), and income eligibility levels for government assistance—overstating the inflation rate had significant implications for the federal budget. A great deal of research and commentary followed, and in subsequent years, the Bureau of Labor Statistics (BLS) made changes to the CPI that dealt with many of the issues raised by the Boskin Commission.[3]

Even beyond the federal budget, the accuracy of the official price measures is of paramount importance. The CPI is also used to index many labor contracts (or to serve as a benchmark), as a key input into the Federal Reserve's decisions about monetary policy, and as a general gauge of the economy's performance. If the CPI and other official measures are incorrect, that mismeasurement has likely contributed to poor economic decisions and policy mistakes as well as implying that efforts to compensate households or others for changes in the cost of living are providing too much or too little compensation. Moreover, given the degree to which elevated inflation has played into political debates, mismeasurement also could have unintended political consequences. Accordingly, the CPI affects millions of Americans and, indirectly, many others around the world.

This paper takes on this question of the accuracy of official inflation measures, evaluating recent critiques of the CPI. We focus primarily on the CPI because this is the most widely known and used measure, though we will also discuss other measures. We believe we are well positioned to consider this question. Sichel was the chair of the Committee on National Statistics (National Academies of Sciences, Engineering, and Medicine) panel that authored the consensus study report *Modernizing the Consumer Price Index for the 21st Century* (NASEM 2022); Mackie was the Senior Program Officer for the study (Sichel and Mackie were the coeditors of the report, hereafter referenced as the *Modernization Report*). The study was commissioned by the BLS to

[3] See also Moulton (2018) and Sichel (2019). Sometimes, however, remedies to correct for biases can create new problems—for example, the chained index formula used to capture the effect of consumer substitutions may understate inflation for certain groups, such as the elderly, if they do not have flexibility to modify their spending patterns.

provide independent guidance as part of its ongoing efforts to continually update their methods to keep up with the changing data landscape and the changing economy itself. The report focused on the potential of alternative data sources to improve the timeliness, detail, and accuracy of the CPI; it also pointed to strategies for improving traditionally difficult-to-measure expenditure categories such as housing/shelter and medical care. This paper draws heavily on the analysis in that report.

Our bottom line is that, for the most part, the CPI provides an accurate and defensible broad measure of inflation. In addition, we would highlight that the BLS performed well under unprecedentedly difficult circumstances during the COVID era—especially during the early months, when much of the nation was on lockdown. Even as the traditional way of collecting data for the CPI quickly became untenable, the price index was published on time every month. Moreover, no serious study has reviewed the agency's performance and called into question the fundamental integrity or accuracy of the data that were released during that period. For the extraordinary effort during that period, the nation owes the BLS a debt of gratitude.

In arriving at this bottom line, we make the case that the CPI is built on a solid methodological foundation and provides important and largely accurate information about inflation trends. We also argue that some recent critiques of the CPI appear to reflect a misunderstanding of the CPI's purpose or its methodology and rely on data that measure something different from what the CPI is intended to measure. We do add the qualifier "for the most part" to our evaluation. There is always room for improvement in economic statistics. Different measures of inflation are appropriate for different purposes, and the CPI may not be the best index to use in all cases. For example, the Federal Reserve's 2 percent target for inflation is based on the price index for personal consumption expenditures (PCE), a broader measure of consumer prices than the CPI, although closely related—and indeed, heavily derived from CPI components.

Moreover, the *Modernization Report* highlights the steps its authoring committee recommended the BLS should take to continue improving the CPI given ongoing changes in consumer markets and the data environment. We touch on many of these recommendations throughout the paper. Fortunately, BLS is making progress on these fronts; however, the agency—along with other statistical agencies—has faced budget constraints that have limited the pace at which they can continue to improve the quality of economic statistics. Indeed, meaningful progress on sustaining and improving the quality of the CPI and other critical economic statistics will require significant additional budgetary resources.[4]

The remainder of this paper is organized as follows: Section 2 briefly describes the conceptual framework underlying the CPI and its mechanical construction, giving special attention to the

[4] A recent report by the American Statistical Association (Auerbach et al. 2024, p. 6) concludes that the nation's federal statistics are at risk in terms of "their ability to produce relevant, timely, credible, accurate, and objective statistics and to innovate to the extent necessary to meet the nation's information and evidence requirements in the 21st century." The report also highlights the "lack of sufficient resources (both budget and staffing levels) to carry out, not only basic responsibilities but also the testing and development to meet demands for new, revised, and more detailed information."

shelter component of the index. Other widely used measures of inflation are discussed as well, along with debates and controversies in the literature about their suitability for various purposes. Section 3 evaluates several critiques of the CPI and proposed steps to address those with the most validity. The focus here is on criticisms that resurfaced during the COVID era—the need to keep up with rapidly changing consumer purchasing patterns; to integrate alternative, detailed, and high frequency data into index construction; to review the methodology and data sources used for the shelter component of the index; and to account for rapidly changing characteristics of goods and services in the marketplace. The distinction between price change and price levels, and the related disconnect that sometimes confuses the general public, is briefly discussed. A concluding section summarizes thoughts on next steps for the BLS as the agency moves forward with its price measurement program.

2. Background

Conceptual Framework

Price measurement is conceptually complicated and data intensive. A central source of conceptual complexity is that no two people or families buy exactly the same things; nor do they always pay the same prices for their purchases; nor do they buy the same bundle of things over time. To cover the broad consumer landscape, each month the BLS collects prices from about 23,000 retail establishments and rents for about 8,000 housing units.[5] While this sample reflects only a small fraction of all the types of goods and services bought and sold in the United States—Amazon alone directly sells over 12 million different products—it is carefully designed to be statistically representative of the goods and services consumers are buying and where they buy them. The magic of the CPI is that it harnesses all of these complexities to produce a single number (actually a set of numbers, as discussed below) that is nationally representative, has a sound conceptual basis, is intuitive, and provides a consistent measure of changes in prices faced by consumers over long spans of time.

The CPI emerged from price measurement efforts during World War I. At that time, prices were rising rapidly, and that backdrop generated a need to track changes in the cost of living in industrial centers for the purpose of adjusting wages. Following the war, in 1921, regular publication of a national index—the US city average—was initiated, with data extending back to 1913. Many methodological updates and improvements have been incorporated since.[6]

While the CPI began as an index purely tracking the cost of a fixed basket of items, over time it evolved into what is known as a conditional cost-of-living measure, or COLI. That is, the CPI's underlying framework or intent is to track how much a typical household would need to change its expenditures over a given period to maintain its utility or material standard of living. To our ears, that is a sensible and intuitive approach to thinking about inflation.

[5] See https://www.bls.gov/opub/hom/cpi/data.htm.
[6] For a detailed history of the CPI, see BLS (2023) at https://www.bls.gov/opub/hom/cpi/home.htm.

Estimating a true COLI is aspirational given that we cannot realistically calculate the amount of money needed to hold living standards (or utility) constant over all consumers. Accordingly, the modifier "conditional" is included because, in practice, the index covers only private goods and services and holds constant environmental background factors—including life expectancy, crime rates, and the environment.[7]

While the conditional COLI approach certainly has limitations, it is the most widely used and accepted methodology for measuring inflation. Indeed, statistical agencies around the world have generally settled on the conditional COLI approach to measuring changes in the price level.

Several features of the CPI are relevant for evaluating recent critiques of the CPI or comparisons with other measures of inflation. First, as noted, the CPI is nationally representative, with a sample (of both prices and households' expenditures) that is carefully chosen to be statistically representative. The most widely cited headline index, the CPI-U, represents over 90 percent of the US population. Specifically, the index covers all urban households in core-based statistical areas (a large urban area and surrounding economically integrated jurisdictions) and in urban places of 10,000 inhabitants or more.[8] In contrast, some privately produced price indexes rely on data gathered from a sample that may not be representative, whose characteristics may change unpredictably over time, and for which the motivation for collecting data may have little to do with obtaining a consistent and reliable measure of inflation.

Second, the CPI is designed to measure changes in the cost of living for a typical household's purchases, usually defined by average expenditure shares across all households. Thus, the inflation impact of price changes that affect only a fraction of all households would have a relatively modest impact on the CPI, unless the price changes were extremely large. For example, if rents on newly leased housing units rose significantly while rents on many previously leased units did not change, the CPI would record a rent increase that reflected both the rise in rents in new leases but also the stability in rents in other housing units.

The CPI's focus on average expenditure shares across households also dictates that there is no single "true" rate of inflation, and price changes measured by the CPI inevitably differ from those experienced by a particular household. Indeed, prices faced by any individual, family, or household vary depending on what they buy and where they buy it—a household whose members make long commutes makes different purchases than does a mostly work-from-home household, and may pay different prices for a range of items. As another example, an analysis of data from Adobe's Digital Economy Index found that online prices over the period 2014 to 2017 rose by about 3 percentage points less than the increase in overall prices during that period.[9]

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[7] The COLI approach can be contrasted with a conceptually simpler "cost of goods" approach, where the underlying idea is to measure how much the cost of a fixed set of goods and services has changed over a given period. See NRC (2002) for a discussion.

[8] See www.bls.gov/opub/hom/cpi/design.htm.

[9] The difference between online and brick and mortar price changes also connects to differences in household income. Goolsbee (2021, p. 150) notes that "shopping online is far more common among high-income people…and during the pandemic the practice has grown more prevalent."

Accordingly, the observation that a household's inflation experience differs from the CPI does not necessarily imply that the CPI is incorrect, just that it is not measuring that particular household's rate of inflation. It is especially noteworthy that, as indicated above, the CPI only measures the inflation experience of urban consumers (that is what the "U" stands for in CPI-U). An analysis by the Congressional Budget Office[10] estimated that rural areas experienced higher inflation than urban areas during the early periods of the pandemic, which again points to the fact that the CPI reflects the inflation experiences of some groups better than others.

Third, the CPI adjusts prices for quality change. That is, if a product's posted price does not change but the quality improved by 10 percent, the CPI would, in principle, record a 10 percent price decline, a so-called quality-adjusted price change. This feature implies that the CPI may not line up with casually observed changes in posted prices. In a similar vein, suppose cookies cost $5 for a package of 10, but that the size of the package dropped to 8 cookies still priced at $5. In this circumstance, the CPI would record an increase of 25 percent to reflect the "shrinkflation" as the price per cookie rose from $0.50 to $0.625; that is, basic shrinkflation is captured in the CPI.

Fourth, the weights used by the CPI to combine price changes for different goods and services are updated annually with a lag but are fixed within any calendar year. Under current methodology, the weights introduced in January 2023 were based on spending patterns from the 2021 Consumer Expenditure Survey.[11] This lag can create difficulties, such as during COVID when expenditure patterns changed dramatically but were not picked up in the CPI in a timely way. For example, when the pandemic hit, airfare purchases plunged, along with their prices. The CPI picked up the drop in prices but applied too large a weight to those falling prices since it took some time before the weight on airfares was updated, thereby understating inflation.[12] Furthermore, as the pandemic eased and air travel was recovering, the very low weights from early in the pandemic were then folded into CPI calculations, causing the opposite problem. Even in retrospect, it is not possible to align the timing of expenditure shares and price change, because by convention the CPI is not revised, except in rare instances to correct an error,[13] and the expenditure shares are not available as quickly as the price quotes.

As noted, CPI weights are fixed for the year and do not change month to month, making the CPI a quasi-fixed-weight price index. (A true fixed-weight index would leave the weights the same for all time.) Accordingly, demand shifts in response to changing prices during a year will not be captured in the CPI. For example, if egg prices rise substantially mid-year and purchases drop back as consumers shift to other items whose prices did not rise as much, the CPI would continue to apply the same weight to egg purchases even though the quantity of eggs purchased fell. This approach would lead to an overstatement of inflation, as too high a weight

[10] See www.cbo.gov/system/files/2022-01/57794-Smith.pdf.
[11] Prior to January 2023, updates of weights used a different procedure that created even longer lags between the time spending patterns were measured and when the weights were applied to the CPI.
[12] BLS discussed these issues in Matsumoto, Miller, and Montag (2022).
[13] BLS maintains an Errata page (https://www.bls.gov/errata/) to document the date of corrections and their status.

would be applied to the surge in egg prices.[14] Bias from this source is known as substitution bias.

Measuring the Cost of Housing in the CPI

One particularly consequential element of the CPI's conceptual framework is the treatment of housing. Indeed, among policymakers, researchers, and the media, the rising cost of shelter—specifically rents, which soared during and immediately after the pandemic—has received sustained attention. Concerns over the cost of shelter are heightened by the fact that it represents by far the largest monthly expense for most families. In April 2024, shelter made up 36.1 percent of the CPI by expenditure share. The growing housing affordability crisis, especially acute among renters, adds to the focus on measurement of issues.[15]

The large share of family budgets that goes toward housing also means that it asserts an outsized influence on inflation calculations. In recent years, the CPI shelter component has risen in the 5-6 percent range over 12-month periods. CPI shelter inflation was at 6 percent as recently as January 2024 (and 5.2 percent in August), versus a typical rate of 3-4 percent pre-pandemic (as shown in figure 2). Without shelter, the 12-month increases in the CPI would have ranged from 1.1 to 2.3 percent from September 2023 through August 2024; with shelter included, the index is noticeably higher.

The methodologies used for the CPI for rent and for owner-occupied housing are discussed in detail in the next section.

Other Widely Used Measures of Inflation

Given the CPI framework and the diverse applications of price measurement, the headline CPI cannot be the best measure of inflation for every purpose; no single index can be. For example, adjusting income thresholds for government assistance programs may best be done with a price measure that captures the inflation experience of lower-income households that are most likely to use those programs. And although it is not current practice, indexing Social Security may best be accomplished with an index that captures the experiences of older households that tend, for example, to have higher expenditure shares on medical care. Although the CPI is far and away the best-known gauge of inflation, government statistical agencies produce several other important price indexes.

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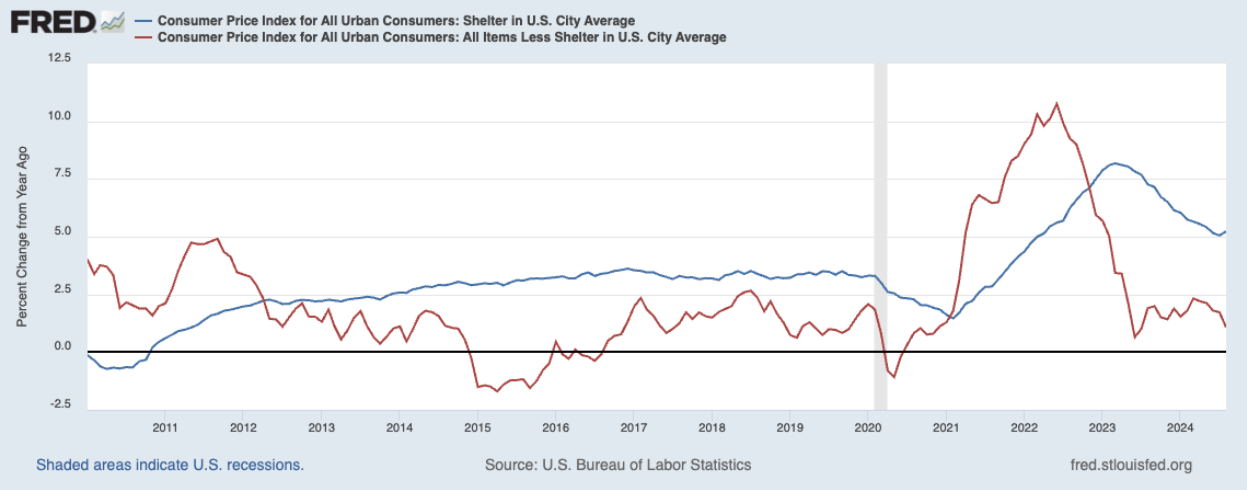
[14] Other price measures allow weights to change month-to-month, including the chained CPI and the price index for personal consumption expenditures. The CPI cannot do the same in real time due to data limitations and because of the convention to not revise the CPI (one exception is revisions to seasonal factors in the BLS's seasonally adjusted series).

[15] The Census Bureau tracks housing cost burden—the number of households that spend more than 30 percent of their income on shelter—using the American Community Survey, an alternative source of data on rent and utility expenditures (and income levels). See www.census.gov/library/stories/2022/12/housing-costs-burden.html). Also, using data from Zillow, a *Washington Post* (2024) analysis of homelessness concluded that rising rents has been a central contributor to the problem.

Figure 2 CPI shelter versus CPI all items less shelter (percent change from a year earlier)



Source: Bureau of Labor Statistics (BLS) data as processed by the Federal Reserve Bank of St Louis.

The BLS produces several variants of the CPI as well as detailed information on price changes for individual items. Table 1 shows the most important of these CPI variants. The most extensively used version of BLS's inflation measure is the Consumer Price Index for All Urban Consumers (CPI-U). The so-called "core" CPI is the CPI-U excluding food and energy. Prices of those items can be volatile, so the core measure often gives a better read on underlying trends in inflation. For analyses that require deflating prices or dollar values on a consistent basis over a long time period, researchers often turn to the CPI's Retroactive Series (R-CPI-U-RS, formerly known as the Research Series) since it adjusts the readings from previous years to reflect current methodology. Another important variant is the chained CPI (C-CPI-U) which more fully takes into account modifications by consumers in their buying patterns in response to changes in relative prices. The chained CPI measure of inflation typically runs a bit below the "regular" CPI-U, reflecting that consumers tend to modify purchases in response to price changes to improve their material well-being. The R-CPI-E provides a measure of inflation for Americans over 62 using weights that reflect different patterns of purchases.[16] The CPI-W reflects buying patterns of wage earners and clerical workers, who currently represent about 29 percent of the US population. Regional CPIs also are available, as is component detail at a high level of disaggregation.

The BLS also publishes the producer price index (PPI)—used to measure changes in the selling prices received by domestic producers (thereby excluding things like imports and sales taxes), as opposed to the CPI's focus on changes in prices consumers pay at the retail level—as well as price indexes for imports and exports.

[16] Although the R-CPI-E attempts to more realistically capture the market basket composition of consumers over the age of 62, it assumes that older consumers execute their purchases through the same outlets as the overall population.

Table 1 CPI indexes produced by BLS

CPI variants	Description
CPI-U	Headline index described above for urban households
Core CPI	Prices for all items excluding food and energy
R-CPI-U-RS	Research index incorporating current methodology back in time
C-CPI-U	Chained CPI that adjusts expenditure shares every month
R-CPI-E	Research index covering Americans 62 years of age and older
CPI-W	Urban hourly wage earners and clerical workers
Regional CPIs	For various regions and sizes of urban areas

Inflation measures have also been developed in an attempt to capture the experiences of various subgroups within the population. For example, the BLS has estimated CPI-like indexes for subgroups positioned at different points along the population's distribution of income. These analyses are typically based only on differences in the mix of goods and services that are purchased by the specific group, with different spending weights then applied to the same set of underlying basic (item) price indexes. So, for example, this kind of index could capture that households with lower incomes are more likely to spend a larger share of their budget on shelter, which would be reflected in a higher weight assigned to that expenditure category. Since prices for shelter rose faster than average overall prices in 2022, the overall inflation measures for households in the lower quintile group would be pulled upward. Similarly, these indexes would show lower-income households being disproportionately impacted by increases in the price of food, since that category constitutes a higher portion of their expenditures. However, subindexes based on differences in expenditure shares would not account for cases in which different groups pay different prices for the same items due to outlet accessibility or other reasons.

Other researchers have taken more experimental approaches to estimating differential price inflation across the income distribution. Jaravel (2018) used transaction data from the Nielsen Company on specific goods purchased by US households to estimate inflation rates as a function of income. For consumer goods observable in the Nielsen data, such as food products, household supplies, and health and beauty products—which account for 30-40 percent of expenditures on goods, or about 15 percent of total expenditures—Jaravel (2018) incorporated product-level data on both prices and quantities. One finding, for the 2004-15 period, was that annual inflation was approximately 0.65 percentage point lower for households earning above $100,000 a year when compared with households making $30,000 or less per year (*Modernization Report*, p. 148).

The Bureau of Economic Analysis (BEA) also produces important price indexes as part of the estimation of real gross domestic product (GDP). The most influential of these is the PCE price index, mentioned above, used to deflate personal consumption expenditures in the national

accounts. It has broader coverage than the CPI[17] and also uses a different formula to aggregate prices and better reflects month-to-month shifts in consumer expenditures. In part due to these characteristics, the PCE is the reference statistic for the Federal Reserve in defining its 2 percent inflation target. Due to their coverage and methodological differences, since December 1978, PCE inflation has run about 0.30 percentage point below CPI inflation, although the difference jumps around a fair bit (Janson, Verbrugge, and Binder 2020).

3. Critiques of the CPI; Proposed Steps to Modernize

The underlying methodology of the CPI, pragmatically developed to function in the production environment required of statistical agencies, ensures the monthly release of an objective measure of average price changes faced by American consumers. As noted above, inflation measurement has always engendered controversy, and the set of issues raised during and after the pandemic intensified these critiques. In this section, we review several areas of criticism, focusing on those that have been especially relevant to price measurement experiences of the past 5-10 years, including the recent runup and dropback in inflation. The critiques we consider include:

1. The CPI does not keep up with rapid changes in consumer expenditure patterns.
2. The CPI relies too much on an older methodology and does not sufficiently make use of high detail, near real-time digital transaction data, especially given the fading viability of the 20th century survey-centric paradigm.
3. The CPI's method of tracking changes in the price of shelter does not reflect what is really happening in housing markets.
4. The CPI does not sufficiently keep up with an increasingly dynamic marketplace in which the characteristics of goods and services evolve more quickly than ever.
5. While inflation has slowed, prices are still up substantially since before the pandemic, creating burdens for many households.

As noted, the BLS is well aware of these critiques and, as was the case with the 2022 *Modernization Report*, has periodically sought outside expertise to help improve its methodology. Discussion in this section draws heavily on material in that report.

Criticism 1: The CPI does not keep up with rapid changes in consumer expenditure patterns (or, the need for timely information on c*urrent* consumer behavior)

Bottom line: This criticism has validity**.** While the BLS has largely eliminated substitution bias and made progress in shortening the lag between the setting of expenditure

[17] The CPI covers so-called "out-of-pocket" expenditures, while the PCE price index covers all household consumption. The health care category highlights this difference. The CPI only includes the portion of health care paid for directly by individuals (insurance premiums, copays, and direct payments), while PCE also covers health care financed by the government and employers (to the extent employers share part of the cost burden with their employees).

weights and their use in the CPI, that lag remains 24 months on average. A major update of methodology will be necessary to significantly shorten the lag further.

For many users of economic statistics, timely—in some cases, near real time—data have become the standard expectation. In the context of cost-of-living measurement, this means tracking changes in the prices and quantities of the things that people are buying now, or at least recently, as opposed to in years past. Contemporary information is especially crucial during extraordinary times when the composition of goods and services being bought and sold is changing rapidly from period to period, such as during the pandemic.

Depending on the circumstances prevailing in the economy, the CPI may display upward biases (overstating inflation) or downward biases (understating inflation). As noted, sources of bias in the CPI have also long been recognized. However, one potential source of inaccuracy—the use of outdated information on consumer expenditures—was particularly, and dramatically, exposed during COVID-era economic upheavals. In fairness, COVID-19 shutdowns and post-pandemic adjustments cast a glaring light on the value of timely economic statistics generally. For price measurement, the rapid shifts in consumers' buying patterns—reflecting the types of products demanded in a shutdown economy and by what was available given supply chain disruptions—rendered data that, even if only a year or two old, was unrepresentative of what was occurring then in the economy.

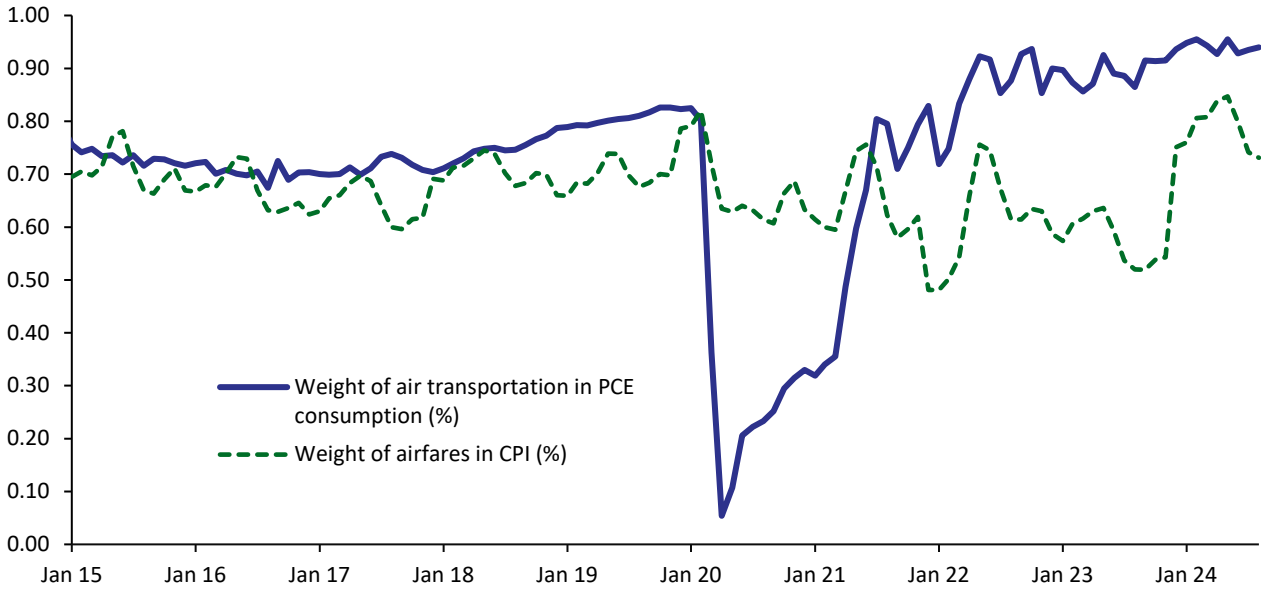
During the economic lockdowns of 2020, the decline in spending on some categories of goods—e.g., travel, food away from home, admissions to movies, theater, and sports—was so severe that it essentially amounted to a "disappearing products problem" (Cavallo 2023; Diewert and Fox 2020). Alternative data sources (that is, sources other than the Consumer Expenditure Survey) clearly reveal massive changes in expenditure patterns for some of these categories. Air travel provides a salient example. Figure 3 highlights the divergence in the expenditure weights assigned to airfares in the CPI and in the PCE estimated by BEA, with the PCE weights capturing the pandemic-related collapse and the subsequent robust recovery in a way not reflected in the CPI weights. The PCE price index is able to update weights more quickly because they are based on data collected from businesses and trade organizations on an ongoing basis.[18] This highlights the importance of firms' willingness to respond to surveys for price measurement and expenditure estimates.

The contrasting stories portrayed by the different data sources provided fodder for CPI critics. While these kinds of expenditure shifts are historical outliers, it is certainly true that cost-of-living indexes based on pre-pandemic weights[19] had become outdated by the end of 2020, at least temporarily, with the above-mentioned items overrepresented while others, such as laptop computers and furniture for home offices, were underweighted. By Cavallo's (2023)

[18] Also, the expenditures shares in the PCE index are calculated from aggregate data, which are much easier to assemble and handle than household-level data of the kind used to construct CPI weights.
[19] Spending weights used in the CPI for the period January 2020 through December 2021 were based on consumer purchases made in 2017 and 2018.

estimates—which took advantage of publicly available data on consumers' credit card transactions captured in near real time—an index reflecting contemporaneous purchasing patterns increased faster than the official CPI. This mis-weighting bias peaked in May of 2020, when Cavallo's COVID index showed that "annual inflation was 1.02 percent compared to just 0.13 percent in the CPI." The divergence was attributed mainly to outdated information on fuel and food at home expenditures.[20] Other researchers came to similar conclusions.[21]

Figure 3 CPI and PCE weights (expenditure shares) for air transportation, 2014-24



Source: *Modernization Report*, generated using data from BEA and BLS.

The benefit from more frequent updating of expenditure share weights is clear, particularly when temporally detailed price indexes are the goal. As the *Modernization Report* concluded, the pandemic and subsequent recovery "made the importance of updating the weights during unpredictable, turbulent times painfully apparent and showed that failure to keep the weights up to date can lead to lost credibility if households cannot recognize the market basket" (p. 63).

Solutions to the problem of outdated expenditure weights seem almost self-evident, but they are not so easy to implement in the context of CPI production and the measurement objectives of the index. Work done on pandemic pricing was illuminating and valuable in advancing price

[20] Food accounts for around 14 percent of the CPI. Purchases of food at home makes up more than half of this category (and more during the pandemic), and grocery price increases (and expenditures) were higher than the averages of other categories early on during this period. See www.hbs.edu/ris/Publication%20Files/Paper_Covid_Price_IMFER_23_4663bd2c-c1a8-4448-aa9f-98a3bc197142.pdf.

[21] Diewert and Fox (2020) showed a downward bias in official consumer price indices resulting from current calculation methodologies; Reinsdorf (2020) likewise found that biases associated with underweighting of rising food prices and overweighting of falling transport prices to be the leading causes of the underestimation of inflation early on in the pandemic.

measurement methods, but critics who suggest that the BLS should simply adopt those methods are missing some important points. As discussed below, digital transaction data of the kind used in real time analyses only cover a portion of expenditures made by consumers. Scanner datasets, for example, generally do not cover services, which account for about 60 percent of the CPI by weight, and only about half of goods. Other types of alternative data sources covering major expenditure categories—such as housing and vehicles—may help extend the coverage, though these categories would require additional development before being usable for a monthly production index. Additionally, some of the alternative indexes, such as Cavallo's, require data from the CPI as raw material, because he used official price indexes for individual items but with updated weights (Cavallo 2023).

Another alternative approach, the PCE index, also has limitations due to its grounding in expenditure data collected from businesses instead of households. Crucially, as its name indicates, the Consumer Expenditure Survey estimates people's purchases in a way that links buying patterns to households. It would not be difficult to obtain aggregate expenditure shares without a household survey. However, as long as the production of price indexes for population subgroups, such as the older population, or by income group, remains a significant measurement objective for the CPI, purchases must be linked to households. Some countries have gone down the path of relying on aggregate expenditure data to produce their price indexes, but they have made the choice to produce only one headline CPI in a way that has been able to take greater advantage of alternative data sources. What's clear is that the BLS faces a tradeoff as it contemplates the possibility of moving to alternative ways of capturing expenditure patterns: Building the expenditure weights from a dedicated household expenditure survey offers greater flexibility in producing multiple population subgroup indexes, but comes at a cost in terms of processing time and survey data demands. The *Modernization Report* concluded that even if an important priority is to integrate alternative sources to bring more timely data into the methodology, a nationally representative survey to collect data from consumers about their purchases—namely the Consumer Expenditure Survey or a successor, ideally optimized for its role in estimating CPI expenditure weights—will be needed.

However, this defense of BLS methods aside, COVID-era research pointed toward important improvements that could be made to the CPI. To improve timeliness of the index, the *Modernization Report* recommended updating upper-level item category weights—which at the time, on average, lagged 36 months behind actual expenditures—more frequently. The report also called for improving the accuracy of weights for specific items that the Consumer Expenditure Survey "measures poorly and for which alternative data are likely more accurate" (p. 75). Consumer Expenditure Survey weights for clothing, tobacco, and alcoholic beverages are typically well below the corresponding weights in PCE, for example. The panel recommended calculating expenditure weights based on data for a 12-month period ending no more than 6 months prior to their introduction. New CPI weights introduced in, say, January 2025 would reflect expenditure patterns from July 2023 to June 2024.

BLS, it should be emphasized, has already begun moving toward achieving this goal. Beginning in January 2023, the BLS began updating CPI spending weights annually, reflecting spending that

took place from two years beforehand so that, for example, the weights for 2025 will be based on spending patterns in 2023 (an improvement from the prior methodology that would have used average spending patterns for 2021 and 2022). The revised schedule results in spending weights that are lagged, on average, 24 months from the date of the index.[22]

> **Criticism 2: The CPI relies too much on an older methodology and does not sufficiently make use of high detail, near real-time digital transaction data, especially given the fading viability of the 20th century survey-centric paradigm.**
>
> **Bottom line:** This criticism has some validity. The main focus of the *Modernization Report* was on exactly this point, highlighting the need to make wider use of alternative data. The BLS is well aware of this imperative, though making progress is challenging, both for technical reasons and because of constraints on the agency's budget that limit resources available for necessary updates to systems, the data infrastructure, and the composition of staff skills needed for implementation.

BLS has already begun moving in the direction of a blended data approach, having stated its strategic objective to convert a significant proportion of the CPI market basket from traditional collection to nontraditional sources and collection modes, including harnessing large-scale data (*Modernization Report*, p. 25). Pandemic-era constraints accelerated their efforts. This transition requires at least a partial departure from the 20th century survey-centric approach to estimating the CPI. The most essential aspect of the data modernization strategy is tapping into opportunities generated in the digital data environment—specifically, data on prices and quantities generated by electronic transactions, with some important sources described next.

Scanner Data

Integration of consumer transaction data from retail checkout scanners or from households has been in the research (and occasionally) production pipelines of statistical agencies' price measurement programs for decades. Twenty years ago, a Committee on National Statistics panel argued that "scanner technology has the potential to improve the entire process of data collection for the CPI computation" (NRC 2002, p. 275).

To date, most of the BLS's work on integrating data sources generated "organically" by electronic transactions has been for use in constructing elementary indexes, the most detailed item-location level at which prices are aggregated.[23] The agency's research on scanner data (which typically originates with retailers but, with additional technology, can also be collected from households) has mainly focused on obtaining price quotes in place of in-store price checking, and mainly for the food at home category. However, scanner data does offer

[22] See www.bls.gov/cpi/tables/relative-importance/

[23] The CPI tracks the average price change of 243 items (241 commodities and services plus 2 housing item categories) within 32 geographic areas for 7,776 (32 × 243) area-item combinations (BLS 2023). For more see www.bls.gov/opub/hom/cpi/.

simultaneous information on prices and quantities while also making it feasible to vastly expand the coverage of product varieties and outlets. In so doing, traditional small samples of a handful of items to represent broad product categories can, in principle, one day become a constraint of the past (*Modernization Report*, p. 31).

Several national statistical offices are at comparatively advanced stages of their data modernization programs, phasing out survey-based production systems and calculating price indexes directly from alternative data sources. Statistics Norway began research to use scanner data to compute the subindex for food and nonalcoholic beverages in 2005. Statistics Netherlands introduced supermarket scanner data into its CPI in 2002 (de Haan, Willenborg, and Chessa 2016). Beginning around 2008, Statistics New Zealand began researching use of scanner data to estimate price change for products sold by supermarkets and for consumer electronics (*Modernization Report*, p. 35).

Again, though, there are valid reasons why the BLS has not moved more quickly to integrate alternative data sources as some critics would want. Most obviously, scanner data are not available for all commodities. For some items, notably goods purchased online or goods where individual firms have large market shares (e.g., smartphones), scraping price data available on the internet provides an alternative to scanner data or traditional survey-based methods. Even the Australian Bureau of Statistics (ABS), which has incorporated into its CPI a pricing approach that relies heavily on sales data generated at supermarkets (accounting for approximately 84 percent of all expenditures at those supermarket outlets), can only cover about 16 percent of total expenditures using scanner data. These limitations notwithstanding, the *Modernization Report* recommended that the BLS draw on the experiences of statistical agencies in other countries in the adaptation of nonsurvey data sources.

Web-Scraped Data

The most prominent US player in the web-scraped price index research is not a statistical agency, but MIT's Billion Prices Project and spinoff company PriceStats. PriceStats currently tracks about 25 million prices per day from 1,100 retailers in 50 countries. In the United States alone, it collects two million prices per day in real time on a daily basis from not only online retailers such as Amazon.com, but also from the websites of traditional and large multi-channel retailers that sell both online and offline (*Modernization Report,* p. 36).

Out of necessity, on March 16, 2020, the BLS suspended all in-person data collection due to pandemic shutdowns. CPI data collectors were instructed "to attempt to collect data normally collected by personal visit by telephone, email, or by internet from the website of the establishment, if a website exists" (www.bls.gov/covid19/effects-of-covid-19-pandemic-on-consumer-price-index.htm). Field staff quickly changed course, filling up virtual carts online to check prices. This process, brought on as a stopgap measure in the face of the immediate crisis, mimicked the in-store price checking activity but stopped short of systematic web scraping. The basic approach would need to be automated (perhaps using PriceStats methods as the model) if timeliness and efficiency gains in data collection are to be fully realized. (*Modernization Report*,

p. 37). The report recommended following up shutdown economy practices by prioritizing development of a systematic approach to permanently automating web-scraping of price data. Opportunities are especially present for the food, electronics, and apparel elementary indexes, where a large share of transactions take place online, and work by other statistical agencies and private-sector organizations have demonstrated feasibility.

A number of national statistical offices in other countries have also pushed forward more aggressively with web scraping in their CPI programs. For example, Statistics Belgium scrapes around six million prices per month in categories such as clothing, footwear, hotel reservations, airfares, international train travel, secondhand cars, consumer electronics, books, and video games (*Modernization Report*, p. 38). ABS systematically uses transactions (and web-based) data in its CPI and was able to provide timely information about shifts in consumer expenditures during the pandemic lockdowns. The agency was also well positioned to deal with disrupted access to outlets, as most of its direct data collection was already conducted online or over the phone (*Modernization Report*, p. 30).[24]

Quality of Alternative Data Sources

Among the challenges of integrating alternative data sources into official statistics is the need to develop methods for assessing the quality of nonsurvey data. A previous expert committee recommended that federal statistical agencies adopt broader methods for evaluating nonsurvey data that step beyond conventional sampling statistic metrics and that take into consideration dimensions that better reflect user needs such as "timeliness, relevance, accuracy, accessibility, coherence, integrity, privacy, transparency, and interpretability" (NASEM 2017, p. 117).

In keeping with this goal, in the context of the CPI, which will increasingly rely on data blended from multiple sources, the *Modernization Report* recommended that the BLS "regularly publish information on the characteristics of alternative data they plan to incorporate. Important quality indicators include the following: number of products covered, number of observations/price quotes, type of price quote (listed price, transaction price, etc.), how many matches of products can be made across periods, extent of coverage within and across expenditure categories, frequency of updates, and level of product detail (p. 46).

Declining Survey Response Rates and Deterioration of the Survey Paradigm

The need to modernize economic statistics is being driven not just by new data opportunities, but also out of necessity in light of questions about the viability of the survey-centric federal statistical system given falling response rates. For the CPI, this trend is particularly problematic for the Consumer Expenditure (CE) Survey, which serves as the basis for constructing item category weights. As documented in the *Modernization Report* (p. 27), "the CE-Interview unit response rate fell from 72.5 percent in October 2010 to 50.3 percent in December 2019, and the

[24] Less than 2 percent of the Australian CPI (by expenditure weight) is collected by field staff in retail stores (www.abs.gov.au/articles/methods-changes-during-covid-19-period).

CE-Diary fell from 73.6 percent in October 2010 to 47.2 percent in December 2019." Response rates declined to even lower levels during the early stages of the COVID-19 pandemic but then recovered somewhat thereafter. As response rates of important federal surveys decline, concerns grow about the representativeness of samples underlying them.[25]

Even if it were not the case that people have become less willing to respond to surveys, the lags associated with collecting and processing information from households about what they buy (and where they buy it) create some well-known biases, as discussed above. In contrast, the arrival and exit of goods is immediately seen in both scanner and web-scraped data when a transaction occurs or is posted online. The breadth and detail of transaction data have the potential to help address concerns about sample representativeness heightened by falling response rates in the CE and underreporting by consumers of their expenditures.

Even with the growing challenges associated with the survey-centric statistical system, for the foreseeable future, traditional surveys will continue to be essential inputs into federal statistics. However, to ready the CPI for this future data environment, "modernization will need to focus on integrating multiple (public/commercial, survey/nonsurvey) data sources. The ability to integrate electronic transactions data—ideally, data that are linked to households making purchases—represents the ideal scenario for price measurement" (p. 52).[26]

Given the backdrop of recent rapid changes in the economy and in data collection for statistical purposes, it is important to also envision what the consumer economy (and the data for tracking it) will look like in 10 or 20 years. Eventually, it seems likely that nearly all consumer transactions will be electronic and generate a trail of data that can be used to construct price indexes—this is already the case in some countries, such as China. Scanner data, web scraping, credit cards, and peer-to-peer payment platforms like Venmo and PayPal all generate information on consumer spending (though they also come with challenges regarding access and privacy). "Tracking electronic payment data could be especially helpful to identify price trends in new or changing services" (*Modernization Report,* p. 51).

It is not overly futuristic to envision an economy in which data on prices and quantities—along with product identifiers and characteristics, and information about outlets where purchased—are available in near real time for transactions of the universe of goods and services sold. Transaction data generated as a byproduct of day-to-day commerce have the potential "to make small sample sizes an issue of the past and reduce sampling error" (Konny, Williams, and Friedman 2019).

Finally, in assessing the promise of a more diverse data approach for constructing the CPI, it would be remiss to not point out that such a strategy comes with its own set of challenges. As extensively described in the *Modernization Report*, obstacles to incorporating alternative data

[25] Declines in response rates have been even more dramatic in the United Kingdom, with response rates falling so low in October 2023 that the Office for National Statistics had difficulty publishing reliable data.
[26] See Ehrlich et al. (2022) for an innovative effort to reengineer the US statistical system along these lines.

sources are very real, and include the sometimes high cost of acquiring data from commercial firms, the nonrepresentative nature of most data collected for "nonstatistical" purposes (e.g., convenience samples), and the lack of transparency in terms of how datasets are created and curated. Also, replacing traditional price collection with data obtained from the private sector may lead the statistical agency to depend on the data providers; "even with strong contract provisions, these data could be changed or discontinued without notice" (p. 41). Thus, "big data" are not a panacea. They are not a perfect substitute for current data collection methodologies; nor do they alleviate the need to address the deteriorating survey infrastructure that underpins many of our key economic statistics. However, even with these cautions acknowledged, the *Modernization Report* argues that—given an appropriate amount of time, adequate resources, and proper attention to quality assessment of nonsurvey data—most of the challenges associated with using alternative data sources can be managed. Supporting this conclusion are the successes demonstrated by statistical agencies internationally incorporating new data methods as well as some success by some US statistical agencies.

Criticism 3: The CPI's method of tracking changes in the price of shelter does not reflect what is really happening in housing markets, with assorted rent indexes telling different stories than the CPI.

Bottom line: While the CPI's methodology for housing leads to the shelter index lagging changes in the market, many recent critiques are invalid. For example, critiques of the CPI based on a comparison of, say, the CPI rent index to an index of currently signed market leases reflect a misunderstanding of what the CPI shelter index is intending to measure.

As noted in Section 2, among policymakers, researchers, and the media, coverage of rising shelter costs—and especially rents, which soared during and immediately after the pandemic—is the storyline that has received the most sustained attention. Some of this attention arises because estimation of the CPI shelter component—whether for renters or homeowners—is methodologically complex, data are collected in a way that differs from other goods and services, and concerns are further heightened by the fact that housing represents by far the largest monthly expense for most families.

The CPI shelter index is based on a methodology that involves sampling approximately 50,000 renters across the country during a year. This sample is divided into six panels with each housing unit in a panel contacted (by phone or in person) every six months on a staggered basis; for example, panel 1 is contacted in January and July. The sampling proceeds regardless of when lease agreements were signed. Accordingly, the rents sampled within a month include some newly signed leases, but also many units for which leases were signed sometime in the past.[27] Respondents are asked about cash rent paid to the landlord for shelter and included utilities,

[27] More precisely, over 80 percent of rentals in the CPI sample each period are tenants continuing to occupy the same unit (www.bls.gov/blog/2022/measuring-changes-in-shelter-prices-in-the-consumer-price-index.htm).

plus any government subsidies paid to the landlord on the tenant's behalf.[28] The only-every-six-months sampling schedule is justified by the observation that, in normal times, rents paid do not change as frequently as do the prices of most other goods and services that are tracked in the CPI. Sampling at six-month intervals also allows the BLS to sample more housing units given budget constraints, rather than relying on a smaller sample that was contacted more frequently.

However, if an apartment is surveyed in January and the rent goes up in February, that increase will not show up in the data until the apartment is surveyed again in July. This practice causes the CPI data to lag behind current conditions, which may be consequential during periods of high inflation, since market rents "adjust more quickly to economic conditions than what landlords charge their existing tenants."[29] Such was the situation that arose during the pandemic.

For rental units, estimating price inflation for shelter is relatively straightforward. However, for owner-occupied units, BLS methodology is more complicated and is referred to as rental equivalence. For an owner-occupied unit, the BLS identifies rental units with similar characteristics and uses the sample rents for those units to estimate the change in rent that would have been paid for the owner-occupied unit. These estimates are used to construct the CPI's estimate of owners' equivalent rent, the part of the shelter index accounting for housing costs of owner-occupied housing.

Criticism of the CPI Rent Index

One prominent strand of media criticism of the CPI's rent index argues that "there's something off in the data"; that it is "based on bad shelter data"; or that it relies on convoluted statistical methods.[30] Such observations typically reference near real-time data published by firms such as Zillow, CoreLogic, or Apartment List that track "asking rents" prevailing in the current housing market.[31] Indeed, as shown in figure 4, the Zillow Observed Rent Index has moved quite differently than the CPI; the other listings-based data sources have shown similar patterns to the Zillow index.[32] Based on these observations, some analysts have concluded that the CPI is incorrectly measuring shelter costs.

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[28] As discussed below, if a unit is owner-occupied, the BLS computes what it would cost to rent that home in the current housing market, known as owners' equivalent rent (OER). Utilities paid by homeowners are measured separately in the CPI.

[29] Speech on "US Economic Outlook and Housing Price Dynamics" by Federal Reserve vice chair Philip N. Jefferson (www.federalreserve.gov/newsevents/speech/jefferson20240520a.htm).

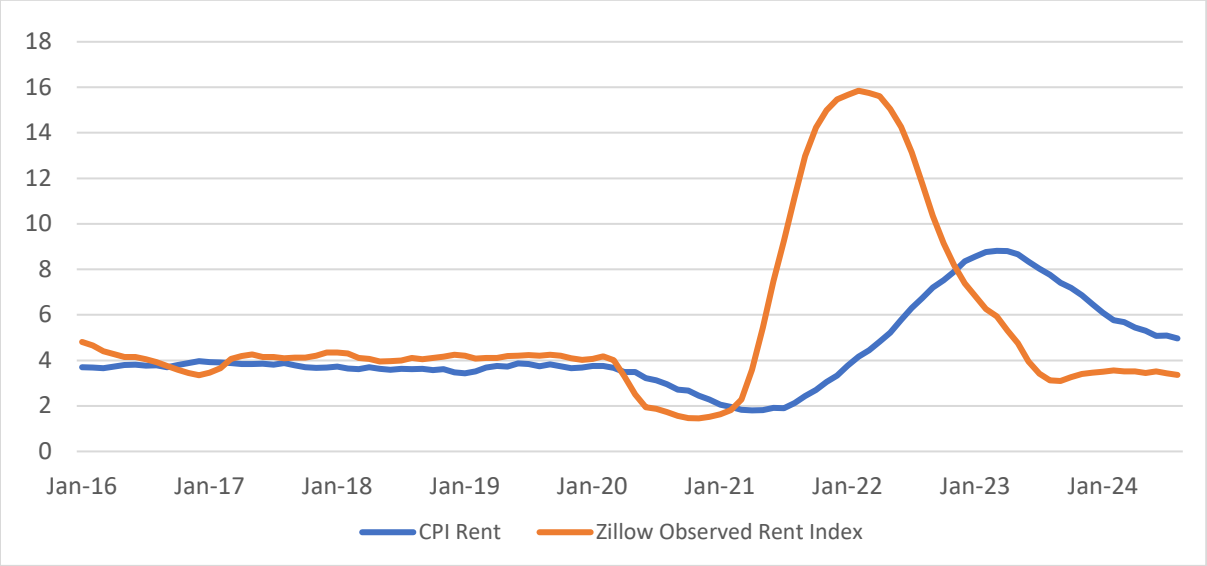
[30] See for example, www.washingtonpost.com/business/2024/03/03/rent-cpi-housing-fed/; https://ritholtz.com/2024/01/cpi-increase-is-based-on-bad-shelter-data/; www.nytimes.com/2024/05/15/business/economy/inflation-owners-equivalent-rent.html.

[31] It is worth noting that just because a market has higher asking rents, it is not necessarily the case that many people are paying them.

[32] See figure 2 in www.frbsf.org/research-and-insights/publications/economic-letter/2023/08/where-is-shelter-inflation-headed/.

However, the CPI methodology differs from that of these private rent indexes in two important ways. First, as noted, the CPI tracks a sample of all existing rents, including for people continuing to occupy their current unit (which is most renters) and who are in stable pricing scenarios, and not just rents on units with newly signed leases (or asking rents). The CPI therefore better represents the average price change experience of all consumers than a sample of current market listings. Second, as noted earlier, the CPI samples rents on housing units only every six months, and this feature means that the CPI will capture rent changes with a lag relative to an index collecting rents every month. Which difference is most important for explaining gaps between the CPI and private rent indexes? Recent research (e.g., Adams et al. 2024) has found the discrepancy in rental inflation rates between the CPI and the alternative measures to be largely explained by differences in rent growth for new tenants relative to that for the broader population of all tenants.

Figure 4 Comparing measures of rent inflation



Source: Bureau of Labor Statistics (BLS) data through Federal Reserve Bank of St. Louis and Zillow.

Differences in approaches to estimating changes in rents occur largely by design. The CPI is intended to capture rent price changes facing all tenants, a large portion of which are rents faced by in-place tenants. In contrast, the focus of commercial firms is typically on the market for available rentals at a point in time which directly represents shelter costs for only a small fraction of the population.

None of this is to say that data on current rental markets is not useful. Media coverage of inflation-rated topics is often focused on a particular item, whether it be eggs, used cars, or gasoline (while the BLS's mandate is to present a broad view of price change for the entire consumer economy). To some extent, this was the case with coverage of shelter, especially by the media which had easy access to commercial data on currently available rental listings, not

lease rates paid by incumbents.[33] A high visibility example of a narrow (but important) cost of living story is the growing unaffordability for younger people seeking to be first-time home buyers. The CPI is not the right place to look to quantify this; in contrast, something like the S&P CoreLogic Case-Shiller price index is—and that index showed that home prices increased in the neighborhood of 40 percent nationally from the end of 2019 to mid-2021.

In contrast, the mandate for the CPI is to measure month-to-month changes in the cost of living for the entire population. The price of houses on the market is an important issue but, as discussed below, house purchases include an investment component, so house prices are not the preferred measure of the cost of housing services period to period. That said, even though the CPI rental pricing method is, in our judgment, sound, additional specialty indexes should still be generated to serve a broader range of stakeholder needs. For example, an experimental quarterly index of new tenant rent (New Tenant Rent Index) produced through a collaboration of researchers at the BLS and Cleveland Fed, "uses a similar method to the Zillow index and data from the CPI Housing Survey . . . to track market rents using only observations in the CPI dataset that follow a change in tenant."[34]

Extending the Rental-Based Methodology to Homeowners

More Americans own than rent their homes. Accordingly, the flow of shelter services provided by owner-occupied houses accounts for three-quarters of the CPI shelter index and more than one-quarter of overall expenditures. One challenge with owner-occupied housing is that the price of purchasing a house reflects both its value as an investment asset, which the CPI in principle should exclude, and as a source of shelter services to its inhabitants, which the CPI must include. To address this challenge, the BLS has used an owners' equivalent rent (OER) approach to measure housing inflation since the 1980s; prior to this, the CPI calculation did in fact track mortgage interest rates and other direct housing costs.

As was sketched earlier, the rental equivalence method essentially estimates the amount that would be required for a homeowner to rent a home with all the characteristics of that household's owned home. Alternatively, it can be thought of as the opportunity cost of living in an owned house rather than renting it out. The most compelling rationale for this approach is that the CPI is intended to capture changes in the consumption cost of the shelter that a house provides; it is not intended to track changes in the price of a housing asset.[35]

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[33] For example, a recent *Washington Post* story on escalating rents used data from the CoStar Group for 1,660 counties for June of each year from 2019 to 2024. See Janice Kai Chen, Rachel Lerman, and Kate Rabinowitz, "How much are rents going up? See how prices have changed in your area," *Washington Post*, August 1, 2024, https://www.washingtonpost.com/business/interactive/2024/rent-average-by-county-change-rising-falling.

[34] The collaboration also produces an All Tenant Repeat Rent Index which tracks the CPI year over year rent index very closely (www.bls.gov/osmr/research-papers/2022/ec220100.htm).

[35] Reiterating this position, a recent report on developing integrated measurement of income, wealth, and consumption (NASEM 2024) categorizes the value of an owned house as a "nonfinancial asset" that is part of wealth. Data from the Federal Reserve's Survey of Consumer Finances and Distributional Financial Accounts, which follows this convention, indicates that owned housing accounts for about 28 percent of total gross household wealth in the United States.

Another motivation for the 1980s-era switch to OER is that, because interest rates and mortgage costs can be extremely volatile (as was dramatically the case during the period leading up to the change), the adoption of the approach has led to a more stable index of inflation over the period since (Hazell et al. 2022). For these and other reasons, the *Modernization Report* recommended that BLS continue to use rental equivalence as the *primary* approach to estimating the price of housing services for owner-occupied units.

Even so, there is room for *secondary* approaches in the shelter index methodology. Imputing rent for owner-occupied homes works best when there is a high degree of overlap in terms of geography and housing quality between the market of homes for sale and the rental market. When overlap of rented and owned properties of a given quality is limited, a user cost approach—which treats an owned home as a capital good and includes actual expenses incurred by homeowners, such as those on repairs, maintenance, financing borrowing, as well as likely capital gains—could add value. Research comparing rental equivalence estimates to user cost estimates for individual properties could be undertaken to help assess where the rental equivalence method is performing well and where it is not, such as may be the case for pricing housing services associated with higher-end properties (NRC 2002, p. 8-9).

Another advantage that OER offers is consistency with underlying approaches used in other official economic statistics and with practices in other countries. While the OER approach is not universally used in the price measurement programs of statistical offices around the world, it is a commonly used approach.[36] Other economic statistics—most prominently, those derived from the National Income and Product Accounts calculated by BEA, such as estimates of disposable personal income—also include imputed rents from homeownership. The NASEM (2024) report on measuring income, wealth, and consumption conveys the underlying logic of OER this way: "Homeownership frees up resources that would otherwise have to be spent on rent. For this reason, for most distributional analyses, estimates of the level of resources available to individuals and households attempt to include homeowner access to housing assets that deliver a cash flow of rental income or a flow of housing services to the owner" (p. 78).

Steps to Improve the Shelter Index, as Recommended by the Modernization Report

While the *Modernization Report* generally supports the methods underlying the CPI shelter index, it highlighted the potential for greater use of alternative data sources, expanding survey coverage, and publishing additional detail about the prices in housing markets.

As described above, the CPI methodology has traditionally relied on survey data to provide information on rent changes and housing expenditure shares. The *Modernization Report*

[36] Canada, Iceland, and Sweden have used the user cost of capital approach; the Czech Republic, Australia, and New Zealand the net acquisition cost approach; Japan, Norway, Switzerland, and the United States the rental equivalence approach. For price quotes (not expenditure weights), the Harmonized Index of Consumer Prices (HICP) used for the Eurozone and European Union currently only includes rentals for housing (paid by tenants) and auxiliary housing expenditures (paid by both tenants and owners).

provides guidance for how the CPI Housing Survey could be supplemented with creative use of market-generated information, and even datasets maintained by the growing number of large institutional landlords and property management companies. Detail in these datasets may help improve the accuracy of imputations of rent changes to owner-occupied houses—for example, by expanding coverage of high-end rentals and single-family homes, both of which are currently underrepresented in the BLS's housing survey. By allowing information for a given housing unit to be collected in consecutive months, as opposed to every six months as is the case with the CPI Housing Survey, the ability of BLS to improve the sensitivity and timeliness of shelter indexes may be enhanced during times when rents change rapidly (*Modernization Report*, p. 8). The report also recommended exploring the value of property tax records, which often include rich data on housing characteristics, and the Census Bureau's American Community Survey data for estimating expenditure shares for owner-occupied housing.

In tracking the price of shelter in the United States, geographic detail is especially important because so much variation exists across and within regions. With this in mind, the *Modernization Report* recommended that BLS publish additional detail on the housing components of the CPI, such as indexes by structure type and for a larger number of metropolitan areas than the roughly 20 areas for which figures are currently available.

> **Criticism 4: The CPI does not sufficiently keep up with an increasingly dynamic marketplace in which the characteristics of goods and services evolve more quickly than ever.**
>
> **Bottom line:** Capturing changes in products and the marketplace has been a challenge since the inception of the CPI. The BLS has continually introduced methodological changes to address this issue although there is, and will continue to be, room for further progress, especially given the growing importance of information goods and services.

For many years, critics argued that the CPI did not adequately adjust observed price changes to account for the changing quality of products and for the appearance of new, often improved goods and services in the market. The report of the Boskin Commission almost 30 years ago highlighted this problem for price indexes designed with the intent to track the population's true cost of living. BLS responded by extending its use of hedonic methods within its COLI framework to track the characteristics (attributes) of more products being priced for elementary indexes. With this information, adjustments could be made to observed market prices to make period-to-period price comparisons as like-to-like as possible. For example, if airbags were added to a vehicle model, a portion of an observed price change would be attributed to the value added by that feature, as opposed to being assigned as a pure price change. For a more extreme automotive example, the price of a 2024 Tesla could not reasonably be compared to the price of a 1908 Ford Model T without adjusting for changes in characteristics and quality.

Some researchers, while acknowledging major progress by the BLS, argue that still more work is needed to keep up with changes in the marketplace, which is much more dynamic and diverse

than it was just a few decades ago.[37] Many more products exist and a larger share of people's market baskets consists of information goods and services; thanks to the internet, people's choice of outlets from where to purchase is largely unconstrained by geography; the characteristics of goods and services evolve more quickly than ever, and new goods are introduced more rapidly. Such dynamism increases the need to pay attention to quality change and the mix of products being bought and sold.

Quantifying the gains (or losses) that the internet has brought to consumers is difficult, in part because so much of what is used has no price. The presence of free or less expensive digital goods has been missed (though to what extent is a topic that elicits a wide range of views). For example, today's quantity and quality-adjusted family entertainment budgets, where innovations such as YouTube and streaming services have emerged, may be less expensive than those of decades past, which may have included movie theater tickets and more away-from-home events. Similar changes have occurred with activities such as communicating with family and friends, planning vacations, and paying bills (to say nothing of the consumer surplus generated from the time saved by using the internet).

Brynjolfsson et al. (2020) studied the price measurement implications associated with the emergence of free (or nearly free) services that have become available in the internet age—from the ability to web search to the proliferation of electronic-mediated apps that make it easier (and sometimes cheaper) to hire a ride across town, to taking and sharing photos. They ask how much consumers would need to be paid to do without them. In the United States, search (Google) is the most valued category of free digital goods with a median valuation of more than $17,000 a year, followed by email and maps. One UK-based study using a similar methodology found a wide range of median annual values for different free goods, with search (£1,500) and personal email (£3,500) the most highly valued categories. In comparison, Facebook and some other free apps had much lower values, at £150 to £10 a year, respectively (Coyle and Nguyen 2020).

Even for more conventional goods bought in traditional outlets, electronic transaction datasets are available that often include barcodes that embed information on characteristics of each product. These datasets make it possible to better account for quality change with hedonic techniques given that a change in product codes typically accompanies meaningful changes in the quality of a given product (Jaravel 2018).

Alternative data are also useful for price measurement in the most challenging expenditure categories. For example, for medical care, the *Modernization Report* encouraged BLS researchers to continue their work evaluating how to "take advantage of insurance claims data, hospital data, health plan data, and scanner data on drugs to improve the coverage, detail, and timeliness of price and quantity information in the medical care component of the CPI" (p. 130). This kind of information is also crucial for assessing the outcomes of medical treatments (NRC 2010).

[37] See, for example, www.nber.org/digest/20239/correcting-quality-change-when-measuring-inflation.

As part of its recommendation that BLS accelerate research on methods of blending different types of data sources for the construction of elementary indexes, the *Modernization Report* noted the importance of building quality change measurement into the methods. A key aspect of a multi-pronged data approach involves incorporating information on product attributes in a way that quality change adjustments can be applied. Sometimes this kind of detailed information can be found in product codes but, in some cases, it can also be extracted from retailers' or manufacturers' websites. Methodological improvements along these lines could be consequential when high expenditure items, such as communications goods and services (internet, streaming, mobile, and cable) are involved.

Criticism 5: While inflation has slowed, prices are still up substantially since before the pandemic, creating burdens for many households.

Bottom line: While this observation is correct, it is not a criticism of the CPI or its methodology per se, but rather one based on what the CPI tells us about cumulative changes in the cost of living. Moreover, basic macroeconomic relationships indicate that it would be extremely unwise for policymakers to endeavor to return prices to pre-pandemic levels.

As all but the most price-insensitive shoppers have recognized, the cost of goods and services has increased significantly in recent years. Prices of many items (milk, gasoline, new cars) have since declined from peaks but are still above where they were ahead of the pandemic. The cumulative percent price increase from February 2020 (the last month before COVID-19 pandemic shutdowns) through November 2024 for a set of commonly purchased goods, listed in table 2, illustrates the point.

Table 2 Cumulative price changes for selected items, February 2020 to November 2024 (percent change)

Gasoline	25.3
Household energy	31.7
Food at home (groceries)	26.2
Rent (primary residence)	26.0
New vehicles	20.1
Used cars and trucks	30.9
Apparel	4.1
Medical care	10.7

Source: All figures based on seasonally adjusted CPI-U data from the Bureau of Labor Statistics.

If the current episode replicates historical patterns, prices will not return to pre-pandemic levels. Rather, over time, incomes will tend to catch up and people will grow accustomed to the new price level. Even so, at least until expectations are reset, people readily express that they do not like paying more for stuff than they used to—and, as repeated consumer sentiment

surveys have indicated, this affects their assessment of how the economy is doing. However, recent data indicate that, on average, wages have been outpacing prices in recent months, which should ultimately help allow people to make the mental adjustment to a new normal.[38]

Furthermore, even though the pain to families of higher prices is very real, from a macroeconomic policy perspective, economists broadly agree that a return of prices back to pre-COVID level would be undesirable. It is worth remembering that price deflation was a characteristic of economic episodes such as the Great Depression and Japan's "lost decade" of economic stagnation.

The Federal Reserve targets a positive inflation rate in part to maintain maneuverability to cut interest rates the event of a recession and to "provide insurance against downward movement of prices for goods and services . . . since [many economists] think that the effect of deflation of a given size would be more harmful for the economy than a positive rate of inflation of the same number."[39] Among other reasons that policymakers seek to avoid price deflation include: (1) in a deflationary economy, wages as well as prices often have to fall, "and it's a fact of life that it's very hard to cut nominal wages" and economies typically do not have falling wages unless they also have mass unemployment (Krugman 2010); with expectations that things will cost less tomorrow, consumers are encouraged to put off purchases, creating a potentially enormous shortfall of demand relative to supply; deflation is bad for debtors which leads to spending cuts and greater defaults; and it is difficult for central banks to cut interest rates below zero.[40]

4. Conclusion: A Crucial and Sound Statistic but More Work Ahead

The CPI has been the subject of especially intense criticism in recent years given the turmoil of the pandemic and the sudden increase and subsequent dropback in inflation. This paper, in evaluating several of the most salient recent critiques of the CPI, reaches three main conclusions. First, that the underlying foundation of the CPI is sound. The conditional cost of living framework is sensible, intuitive, and implementable for a statistic published on a monthly production schedule. The basic question the CPI is designed to answer is: "How much did the cost-of-living change for an average household in the United States over a specified time period?" Our judgement is that while there is essential further progress that the BLS will need to make, the CPI does a solid job of answering that question.

Second, with respect to criticism that CPI methodology needs to be more responsive to changes in the economy and the data environment (specifically, criticisms 1, 2, and 4 above), the *Modernization Report* argued for a paradigm shift from a 20th century survey-centric approach to one that blends traditional survey data with alternative data (including so-called "big data").

[38] BLS data indicate that average hourly earnings (nominal) have increased about 19 percent since February 2020 (calculated using the FRED tool at https://fred.stlouisfed.org/series/CES0500000003).
[39] See https://www.stlouisfed.org/open-vault/2019/january/fed-inflation-target-2-percent.
[40] See www.brookings.edu/articles/5-reasons-to-worry-about-deflation/.

The need for this shift is given added urgency by declines in survey response rates and the growing availability of new data sources with complementary features that can improve economic statistics. While it is easy to say that a paradigm shift is needed, such a shift raises methodological challenges, including new procedures for calculating indexes from blended data and new approaches to evaluating data quality. And the challenge is larger than that. To succeed in making the necessary changes, the BLS will require significant additional resources, changes in the skill mix of its staff, changes in data security protocols,[41] and changes in its administrative structure. None of these changes are easy; all are essential.

Third, some critiques (for example, criticism 3 above) reflect a misunderstanding of what the CPI is designed to measure and of its intended purposes. Critiques of the official measure sometimes take the form of highlighting an individual with a different inflation experience than that reflected in the CPI or an alternative index that reports a different inflation rate than does the headline CPI. In many cases, the alternative indexes are measuring a different concept than the CPI or are using very different data that may not be nationally representative. The CPI is designed to answer questions about changes in the cost of living averaged across households in the United States, conditional on a set of background factors. If the question is different, the headline CPI may not provide the best answer. Accordingly, the BLS publishes a number of variants of the CPI that focus on different demographic groups or use somewhat different methodologies. Other statistical agencies also publish a variety of inflation measures, and private researchers and analysts have generated alternative measures as well. In analyses of inflation developments, it is critical to match an inflation measure to the question being asked as well as possible.

Housing, and specifically rents, provide an illuminating example of the occasional mismatch between what the CPI is measuring and what an alternative indicator captures. A number of critiques have highlighted privately produced indexes of rents built into new leases, and have noted that these indexes rose or fell faster than the CPI over some period. These rent indexes provide valuable information for analysts and policymakers. However, they measure something different than the CPI. While rents on newly signed leases could be changing rapidly, rents on leases signed in earlier months may not be changing much. The CPI incorporates rents for all renters, not just those who have newly signed leases. Thus, care is required to make meaningful comparisons of the CPI rent index to other rent indexes. That said, we do believe there is scope for improvement in the CPI's housing indexes, along the lines highlighted above.

Finally, we note that the critique concerning the level of prices highlights a concern about what the CPI tells us, not a critique of the CPI itself. For those who are more concerned about the cumulative increase in the price level over some period, the information is there in plain sight; all that is required is a slightly different computation using the CPI.

[41] The need for updated security protocols and state-of-the-art release technologies is highlighted by recent incidents in which the BLS mishandled a release of key data. See Casselman (2024).

Looking ahead, we are generally optimistic about the future of the CPI. We believe the conceptual framework of the CPI is sound, and while the road likely will be bumpy, the BLS and the broader set of statistical agencies can rise to challenges that lie ahead.

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