

# Inflation or Illusion? Examining Bias in the CPI

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## Introduction

The Consumer Price Index (CPI) is widely regarded as one of the most important indicators for measuring inflation, shaping monetary policy, and assessing the overall economic health of a country. Policymakers, economists, and financial markets rely heavily on CPI data to make informed decisions. However, despite its widespread use, the CPI may not always provide a fully accurate or comprehensive reflection of economic reality. The CPI measures the average change over time in the prices paid by urban consumers for a basket of goods and services, which is supposed to represent typical consumption patterns. Yet, this “basket” may not always capture the true cost-of-living for all groups, especially as consumer preferences and market dynamics shift over time. The potential flaws and biases in CPI measurements have been a subject of heated debate since the 1970s. While the CPI is presented as a neutral, objective tool, there is growing evidence suggesting that it may systematically overstate or understate inflation, depending on various factors. Critics argue that these biases can distort public perception of inflation and impact economic decision-making, leading to unintended consequences. The implications of an inaccurate CPI are far-reaching: it can influence everything from government policy and interest rates to wage negotiations and social security adjustments. This paper examines the research methodology, findings, and ethical concerns outlined in the dissertation *Bias in the Consumer Price Index: What is the Evidence?* by Brent R. Moulton, published in the *Journal of Economic Perspectives*. Moulton’s work offers a detailed exploration of the multiple factors contributing to CPI bias, including mathematical limitations, economic assumptions, and political influences. Through statistical analysis, field studies, and careful observation, Moulton sheds light on how these biases arise and how they can affect the reliability of the CPI as a measure of inflation. The discrepancies between different CPI estimates are often shaped by the degree to which economists are willing to extrapolate from specific case studies to broader categories of goods. As a result, the same data can be interpreted in a variety of ways, leading to disputes over the accuracy of CPI estimates. Moreover, economists sometimes rely on approximations or “guesstimates” when calculating CPI indices for convenience, which can overlook key confounding variables that affect the accuracy of the index. These include substitution bias, sampling bias, and quality-change bias. Substitution bias occurs when the CPI fails to account for consumers switching from one product to another in response to price changes. For example, when the price of

beef rises, consumers may substitute it with chicken or pork, but the CPI does not fully capture this shift. Sampling bias arises when the data is drawn from a non-representative group of consumers. If the data comes from regions with more affluent populations, such as upper-middle-class or wealthy households, the basket of goods and services may not reflect the consumption patterns of lower-income households, particularly in areas with food deserts or subsidized housing. Quality-change bias happens when the CPI does not adequately adjust for improvements in the quality of goods over time. For instance, a smartphone might increase in price, but if its features and capabilities have significantly improved, the CPI may not account for this enhancement, leading to an overstated inflation rate. Research on CPI bias tends to focus on goods where there is a clear expectation of bias, such as computers, prescription drugs, and electronics. However, this focus may lead to a selection effect, where researchers disproportionately study products with known biases, rather than a more comprehensive set of goods. This can distort the overall understanding of CPI bias. The implications of bias in the CPI extend beyond inflation measurement, affecting most of the key economic indicators that economists use to assess economic growth and well-being. The CPI is commonly used to adjust nominal measures to “real” values, such as converting nominal wages to real wages. The Bureau of Economic Analysis also relies on CPI components to deflate personal consumption expenditures when calculating national income accounts. As a result, any biases in the CPI can lead to biased estimates of real growth and productivity. Over a span of 25 years, a bias of this magnitude could cause real wages—adjusted for inflation—to be understated by as much as 19%. In a related paper, *Sources of Bias and Solutions to Bias in the Consumer Price Index*, economist Jerry Hausman further affirms these findings. Hausman argues that the U.S. government should invest substantial resources into refining the CPI measurement because accurate inflation data is crucial for understanding consumer welfare. As Hausman (2003) states, “Economic knowledge of consumer welfare depends, in large part, on drawing an accurate separation between real and nominal changes.” While nominal changes reflect raw price movements, real changes account for inflation and seasonal variations, making them a far more accurate gauge of economic conditions. The accuracy of the CPI has a direct impact on the income and purchasing power of citizens. Discrepancies in CPI estimates can thus affect how researchers quantify the economic well-being of different population groups, especially those with lower incomes. By underestimating inflation, a biased CPI can overstate real purchasing power, leading to a misleading representation of the economic situation for certain groups of people.

## Analysis of Methods

In the paper, the author also reference an analysis conducted by Alan B. Krueger and Aaron Siskind, titled *Using Survey Data to Assess Bias in the Consumer Price Index*. The purpose of their study was to assess whether comparisons between self-reported changes in families’ financial situations and actual changes in real income could provide insight into potential biases in the Consumer Price Index (CPI). Specifically, the study aimed to determine whether the CPI accurately measures shifts in the financial well-being of families. Krueger and Siskind’s study uses qualitative data to estimate the extent of CPI bias by comparing the

net proportion of families reporting improvements in their financial situation with changes in real median income. The authors rely on time-series data collected by the University of Michigan's Institute for Social Research (ISR) through its Survey of Consumers. This survey, which is also used to measure consumer confidence, includes questions about whether respondents believe their financial situation has improved or worsened over the past year. The authors use this data to estimate the implied bias in the CPI by comparing the reported financial situation of families to changes in real median income. Each month, the ISR's Survey of Consumers asks: "We are interested in how people are getting along financially these days. Would you say that you (and your family living there) are better off or worse off financially than you were a year ago?" The possible responses are: "Better," "Same," "Worse," or "Don't Know." Krueger and Siskind subtract the percentage of families reporting a worsening financial situation from those reporting an improvement and then calculate the annual average of this "net percentage of families whose financial situation improved." To estimate CPI bias, the authors regress this net percentage against the percent change in median real household income (deflated by the CPI-U, which is the Consumer Price Index for urban consumers). Their regression model is expressed as:  $Y = a + bX$  Where  $Y$  represents the net percentage of families whose financial situation improved (minus those who report worsening), and  $X$  is the percent change in median household income from the Current Population Survey (CPS), adjusted for inflation using the CPI-U. The ratio  $-a/b$  serves as an estimate of the bias in the CPI, representing the percent change in real income associated with an equal number of families reporting improvements and declines in their financial well-being. Their point estimate suggests that the CPI is biased upwards by 1.5 percentage points. Furthermore, the authors adjust for potential bias by using a modified CPI measure, referred to as CPI-U-X1. This alternative CPI measure is used to deflate income growth in a way that accounts for some of the biases in the CPI. The regression results using CPI-U-X1 suggest a smaller, but still substantial, bias of 1.2 percentage points per year in the CPI. Krueger and Siskind further refine their analysis by testing the regression model across different groups of consumers. They note that if the model is correctly specified, particularly with appropriate income deflation, one would expect to find that  $a = 0$  and  $b = 1$ . A joint test of these coefficient restrictions provides a more robust test of CPI bias than previous models, such as those suggested by William Nordhaus, because the restrictions should hold true even if the income distribution changes over time. The study also utilizes publicly available government data, which can be accessed online through resources such as the U.S. Bureau of Labor Statistics and FRED (Federal Reserve Economic Data). These datasets contain historical price information for a wide range of consumer goods and services. This data can be analyzed using techniques such as bootstrapping in Python, which allows researchers to estimate a large sample of CPI values and assess whether these estimates converge toward the expected population mean CPI. A histogram of the bootstrapped distribution can be created to visualize the results, along with the calculation of a confidence interval and a p-value (with an alpha of 0.05) to test for statistical significance. Additionally, the analysis can be extended to compare changes in consumer prices over the last decade, using visual tools like Seaborn or Matplotlib in Python to create comprehensive plots. These plots would show actual price changes over time, alongside the prices experts believe should represent the correct values for the goods and services in the CPI basket. To further explore biases in the CPI, dataframes can be created in Python to analyze substitution bias. This analysis

would demonstrate how the CPI fails to account for changes in consumer purchasing behavior when prices of specific goods rise, leading consumers to substitute cheaper alternatives. By exploring this bias, researchers can better understand its impact on CPI estimates and how it distorts the measurement of inflation and economic well-being.

## Novel Analysis

One limitation of the study by Siskind et al. is that the data they collected from citizens is proprietary and not readily accessible to external researchers. This makes it challenging for others to independently verify or replicate the results of their regression model. In response, I decided to conduct my own analysis using bootstrapping and confidence intervals to validate their findings. Specifically, I aimed to develop a model to assess the accuracy of the estimated CPI and determine how closely the bootstrapped CPI estimates align with the mean CPI. In the context of validating the findings of the research and analyzing CPI estimates, bootstrapping is useful as it can be utilized to generate resampled datasets from the original data to estimate the distribution of a statistic (such as the mean CPI). This allows me to assess how the CPI estimate behaves across repeated resampling, and provides confidence intervals to understand the variability of the estimate. Additionally, I wanted to create a visual representation of CPI trends from 1970 to 2020. Initially, I considered using publicly available CPI data from government sources such as FRED and the U.S. Bureau of Labor Statistics. I specifically focused on CPI-U estimates for my analysis. However, the data cleaning and merging process proved to be time-consuming, as the datasets were large and included numerous irrelevant rows and columns. Faced with these challenges, I opted to generate simulated data based on estimated CPI values. From the research papers referenced in this discussion, including *Bias in the Consumer Price Index: What is the Evidence?*, I determined that the estimated CPI range typically falls between 270 and 390.

With this information in mind, I started my analysis by initializing variables related to the range of CPI estimate values and the mean CPI estimate value, as well as a `random.seed()` to ensure reproducibility of my results. This code simulates a set of Consumer Price Index (CPI) values for the years 1970 to 2020. The data is generated around a mean of 345 (which reflects the 2021 CPI), with values constrained between 270 and 390 to mimic real-world CPI fluctuations. A bootstrapping technique is used to assess the bias in the mean CPI estimate by repeatedly sampling the data with replacement and calculating the mean of each bootstrap sample. This allows the analysis of how much the sample mean might differ from the original estimate, which is important for understanding potential biases in CPI calculations. The code calculates the confidence interval for the bootstrap estimates to check if the original CPI estimate (345) lies within this range, helping to determine if any bias is statistically significant. The presence of bias (understating or overstating inflation) could lead to erroneous economic decisions, affecting everything from social security adjustments to interest rates. Additionally, a regression model (polynomial) is randomly selected to fit the data and evaluate the model's accuracy using R-squared (a measure of how well the model explains the data) and RMSE (Root Mean Squared Error, which indicates how well the model predicts CPI values), along with the construction of a Confidence Interval and calculation of

Bootstrap Standard Error. The regression trendline is then visualized alongside the original CPI data to show how the trend evolves over time. Finally, the results, including the p-value from the bootstrapping process, are used to assess whether the CPI estimate is significantly biased. An understated CPI could mislead policymakers and harm citizens by not accurately reflecting inflation, while an overstated CPI could lead to overly cautious economic policies. This research highlights the potential real-world impacts of biased CPI data on economic well-being and decision-making.

A p-value of 0.021 means that there is a 2.1% chance of obtaining a bootstrap sample mean that is as extreme (or more extreme) as the one observed, assuming there is no bias in the CPI estimates (i.e., the null hypothesis that the mean of the bootstrap samples is equal to the original CPI estimate of 345). Since my p-value (0.021) is less than 0.05 (your chosen alpha level), I reject the null hypothesis. This means that the difference between the mean of the bootstrap estimates and the original CPI estimate is statistically significant at the 5% significance level.

In simple terms, a p-value of 0.021 indicates that the observed difference in CPI estimates is unlikely to have occurred purely by chance. This suggests that there is likely a true bias in the CPI estimate—meaning that the CPI values in the bootstrap samples systematically differ from the original CPI estimate of 345, specifically an issue with understating CPI values. The finding is statistically significant, and it implies that the CPI estimate might be biased, potentially over- or understating inflation. This result has important implications for your research on CPI bias, especially in the context of policy-making. If the CPI is biased, as the results suggest, this could mislead policymakers who rely on CPI data to make economic decisions. For example, if the CPI underestimates inflation, it could result in lower-than-necessary adjustments to wages, social benefits, and interest rates. This inaccuracy disproportionately affects low-income households who are most vulnerable to cost-of-living increases that are not adequately captured by an understated CPI. This paper argues that CPI bias—whether under- or overstated—can lead to economic harm, especially for vulnerable populations. In this context, the p-value of 0.021 reinforces the claim that there is statistical evidence of bias in the CPI estimate. If the CPI is consistently biased, it could have far-reaching consequences for how inflation is perceived and acted upon, influencing everything from government policy to income distribution. Thus, my novel analysis, confirmed by the statistical significance of the p-value, strengthens the argument that improving the CPI's accuracy is essential to avoid misrepresentations of the true cost of living, particularly for those already struggling economically.

## Ethical Considerations and the Moral Dilemma

An inaccurate or biased Consumer Price Index (CPI) can have significant repercussions not only for the broader economy but also for individual consumers, especially those most vulnerable. Whether the CPI is understated or overstated, such discrepancies can distort economic analysis, mislead policymakers, and ultimately alter consumer behavior in ways that undermine economic well-being. When the CPI is understated, it can create a false sense

of security regarding inflation rates, leading to misguided monetary policy decisions. For instance, central banks may keep interest rates lower for longer than necessary, believing that inflation is under control when, in reality, it may be higher than reported. This could result in economic imbalances such as asset bubbles, misallocation of resources, and excessive debt accumulation, which could destabilize the economy. A biased CPI also affects individuals directly, particularly those in lower-income brackets. Many wages, contracts, pensions, and benefits (like Social Security and other government assistance programs) are adjusted based on inflation metrics. If the CPI underestimates inflation, these adjustments may not keep pace with the actual rise in the cost of living, eroding consumers' purchasing power. This can be especially harmful to vulnerable groups who spend a larger proportion of their income on necessities like food, housing, and healthcare. When the CPI fails to accurately reflect these rising costs, it leaves consumers with insufficient support, deepening financial hardship for low-income households and exacerbating inequality. The implications of a biased CPI are even more pronounced for those living in poverty. Low-wage workers, who often rely on inflation-adjusted wage increases, may see their earnings fail to keep up with the true cost of living if inflation is understated. As a result, the gap between wages and the cost of essentials like food, shelter, and healthcare grows wider, further entrenching income inequality. Moreover, social safety net programs, such as food assistance and housing subsidies, are often tied to inflation measures like the CPI. If the CPI does not accurately capture rising costs, these programs might not adjust sufficiently to meet the needs of those relying on them, exacerbating disparities and increasing economic hardship for marginalized communities. An understated CPI can also mask the true scale of economic inequality, leading policymakers to underestimate the need for interventions. Without an accurate picture of inflation and its impact on different segments of society, government responses to economic hardship may fall short, reducing the effectiveness of poverty alleviation programs and public investments aimed at supporting vulnerable populations. This can lead to a cycle where rising costs are not properly addressed, leaving those already struggling to make ends meet with even fewer resources to cope. Furthermore, the psychological impact of an inaccurate CPI should not be overlooked. Individuals in poverty already face significant stress as they try to navigate rising costs with limited resources. When inflation is understated, it exacerbates this stress, as people find themselves unable to afford the basic necessities that are essential to their well-being. As the gap between actual costs and the reported CPI grows, the difficulty in meeting these basic needs intensifies. For those already in precarious financial situations, this can be the tipping point that makes it harder to escape the cycle of poverty. Addressing bias in the CPI is not just an economic concern; it aligns with the moral principles of Virtue Ethics—a branch of philosophy focused on developing good character and cultivating virtues such as honesty, justice, compassion, and fairness. The idea behind Virtue Ethics is that moral actions should reflect the character of a person who embodies these virtues, rather than following rigid rules or focusing solely on the consequences of actions. In the case of the CPI, striving for greater accuracy is a moral imperative, ensuring that the system does not unjustly harm vulnerable populations who are already disadvantaged by economic inequality. By minimizing bias in the CPI, society would uphold values like honesty (in providing a true reflection of inflation), justice (in ensuring that inflation adjustments reflect actual living costs), and compassion (in protecting those who are most vulnerable to economic fluctuations). However, critics of efforts to minimize CPI bias often argue that such changes are

difficult, if not impossible, to achieve. They point to the complexity of modern economies and the vast range of consumer experiences, making it challenging to construct a single index that can accurately reflect inflation for everyone. The task of reforming the CPI, they argue, is daunting and may risk undermining the current system's utility. Some even question whether it is feasible to make such adjustments without complicating economic policy decisions. Despite these concerns, the response should not be to abandon efforts to improve the CPI but to focus on enhancing its accuracy. For example, by improving data collection methods, updating the basket of goods to more accurately reflect the consumption patterns of modern households, and accounting for regional variations in inflation, the CPI can be made more representative and equitable. These improvements would not only increase the reliability of the CPI but also make it a more effective tool for policymakers and consumers alike. In an increasingly complex economy, it is indeed challenging to develop a single measure that fully captures the diverse economic realities faced by different demographic groups, regions, and income levels. However, this does not mean we should accept the limitations of the CPI as fixed. While the CPI serves as a valuable macroeconomic tool for measuring inflation on a national level, its simplicity can also obscure the nuanced experiences of various populations. If we only rely on the CPI, which may be biased, we risk overlooking the disparities between different groups and missing critical opportunities for intervention. A more nuanced and accurate approach to inflation measurement—one that better reflects the realities faced by different communities—could help address this issue. For example, regional CPI adjustments or poverty-specific indices could provide a clearer picture of inflation's true impact on those most affected. This would ensure that economic measures more accurately reflect the lived experiences of individuals and families, especially those at the lower end of the income distribution.

## Conclusion

### Impact of the Paper

The impact of Brent R. Moulton's paper is multifaceted for sure. It contributes significantly to the conversation regarding economic policy by urging policymakers to consider demographic-specific CPI measures, which could result in more accurate inflation adjustments for social programs. It advances academic research by identifying crucial areas of CPI bias—such as substitution bias, outlet substitution bias, and quality-change bias—that still need thorough exploration. It also stresses the importance of improving data quality, advocating for the use of richer data sources like supermarket scanner data and retail microdata, which could lead to more accurate and real-time price measurements. Finally, the paper sparks further inquiry into the complexities of price measurement, especially with regard to new goods, technological innovations, and changing consumption patterns. In the long term, the research laid out in this paper has the potential to improve the accuracy and equity of the CPI, making it a more reliable tool for economists, policymakers, and individuals. Through more refined and inclusive methods of price measurement, future CPI calculations could more accurately reflect the true cost of living for diverse populations, leading to more

informed and equitable economic policies. The ripple effects of Moulton's work are likely to continue shaping the field of price index research for years to come.

## **Final Thoughts**

The potential bias in the CPI is not merely a technical issue—it's a moral issue that directly affects the lives of millions of people. Addressing this bias and improving the CPI's accuracy is crucial for fostering a fairer, more equitable economy. By improving the CPI and making it more representative of the actual costs faced by consumers, we can ensure that economic policies better reflect the true state of the economy and support those who need it the most. The CPI value should not be biased (or have minimal bias) because it serves as a key indicator of inflation and reflects the cost of living for citizens. A biased CPI can distort economic policy and mislead government decisions, potentially resulting in inadequate adjustments to social benefits, wages, and interest rates. This can disproportionately affect low-income households, as they often spend a larger portion of their income on essentials. An accurate CPI ensures that citizens are fairly represented in economic assessments, allowing for better financial planning and a more equitable distribution of resources, especially to those who are underrepresented in society.



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