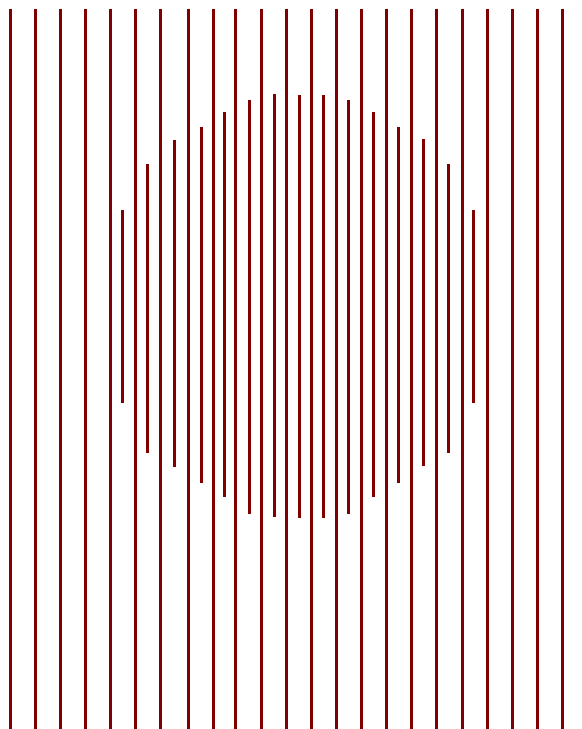


CBO PAPERS

**IS THE GROWTH OF THE CPI
A BIASED MEASURE OF CHANGES
IN THE COST OF LIVING?**

October 1994



CONGRESSIONAL BUDGET OFFICE

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**CONGRESSIONAL BUDGET OFFICE
SECOND AND D STREETS, S.W.
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PREFACE

The growth of the consumer price index published by the Bureau of Labor Statistics is widely used as a measure of the increase in the cost of living. Numerous researchers have argued, however, that changes in the consumer price index do not truly reflect changes in the cost of living, and the results of recent studies have intensified the debate. This Congressional Budget Office (CBO) paper--prepared at the request of the House Committee on the Budget--analyzes the arguments about the degree to which changes in the consumer price index may, on average, overstate the increase in the cost of living--that is, the degree to which the measure may be upwardly biased.

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Sherry Snyder edited the paper, with the assistance of Chris Spoor, and L. Rae Roy and Dorothy Kornegay prepared it for publication.

Robert D. Reischauer
Director

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SUMMARY

As a measure of the cost of living for the overall population, the consumer price index (CPI) is probably upwardly biased--that is, it tends to overstate the increase in the cost of living. Although the amount of bias is not known, the existing empirical evidence, which addresses many but not all of the potential areas of mismeasurement, indicates that the CPI has probably grown faster than the cost of living by between one-fifth and four-fifths of a percentage point in recent years. Other potential areas of mismeasurement that have not been subjected to empirical examination may offset or add to the bias that the empirical studies have found. Because the CPI is widely used as an indicator of both the cost of living and inflation, a bias in that index could distort economic decisions, government spending programs, and tax policies. Because of the importance of this issue, further study is warranted.

Users of cost-of-living indexes should be aware at the outset that numerous theoretical and practical difficulties are associated with measuring the cost of living and that all estimates are subject to a great deal of uncertainty. Even if all of the necessary data were readily available, fundamental problems would arise in deciding what should be included in a cost-of-living index and how best to measure the cost of living. For example, rapid changes in medical care and the potentially huge valuations that could be placed on new treatments or cures make medical care one of the thorniest problems in developing a cost-of-living index. Numerous practical problems also arise: not all of the data are readily available; and an immense effort is needed to ensure that consumers' shopping patterns are reflected in the data samples and that the value to the consumer of new and substitute goods and services is properly estimated.

The use of a price index that is based on the spending habits of one group of people to approximate the changes in the cost of living for another group introduces another potential for mismeasurement. For example, the spending patterns of the elderly are, on average, quite different from those that are used to construct the CPI. Medical care constitutes a greater percentage of the expenditures of the elderly than of the population as a whole; and the medical care component of the CPI, as currently measured, has been increasing more rapidly than the overall CPI. For that reason, an experimental index for the elderly increases more rapidly than the regularly published CPI. The current measure of medical care, however, may be biased upward. In addition, other nonmedical categories of the CPI may suffer from

a similar upward bias. If so, the growth of the CPI may, in fact, be similar to or even overstate the true increase in the cost of living for the elderly.

An overestimate of the increase in the cost of living of even half a percentage point, if not generally recognized, may seriously distort private and public economic decisions. Overstatement would obviously mislead decisions about cost-of-living adjustments to wages and other contracts, entitlement programs, and income tax brackets. But overstating the growth in prices could also affect a number of other decisions because, for example, measures of trends in the growth of real gross domestic product, real wages, and productivity would be lower than they should be. In addition, mismeasurement may lead to unintended real transfers of wealth among various groups.

The Bureau of Labor Statistics, the agency that produces the CPI, is well aware of these issues and is examining ways to address them. In fact, the bureau will institute some changes in January 1995 that are likely to reduce the degree of bias.

CHAPTER I

INTRODUCTION

The consumer price index prepared by the Bureau of Labor Statistics (BLS) is widely used as a measure of inflation and changes in the cost of living. The concept of inflation differs slightly from that of changes in the cost of living. Inflation is a general, persistent change in prices of both consumer goods and goods not directly bought by consumers, such as industrial machinery. By contrast, measures of the change in the cost of living show how changes in prices affect consumers' well-being. Therefore they should include only consumer goods and should take account of how consumers can change the composition of the goods they buy to maintain their level of well-being.

The compilation of the consumer price index is a massive undertaking requiring extensive surveys and periodic revisions. Currently, the BLS publishes two versions of the national index every month. One is based on the 1982-1984 average spending patterns of all urban consumers (the CPI-U), thereby reflecting the prices faced by about 80 percent of the population. The other is based on the 1982-1984 spending patterns of urban wage earners and clerical workers (the CPI-W, defined by the BLS to include only workers paid by the hour); about 32 percent of the total population. The BLS surveys about 25,000 outlets each month and collects prices for about 95,000 goods and services. One-fifth of the sample of items selected for price quotes is updated every year in a process called sample rotation. And in recent decades, the basic expenditure shares, or weights, used to compile the indexes have been updated every 10 years. In 1998, the two indexes will begin to reflect the expenditure patterns for the 1993-1995 period instead of the current 1982-1984 weights.

The consumer price index is an important statistic. Because it is used as an indicator of inflation as well as a measure of the growth in the cost of living, it affects both economic policy and private-sector decisions. Perceptions of real economic growth, trends in productivity, and real wages are influenced by the reported changes in the CPI. As a measure of the cost of living, the CPI is used to adjust payments from federal transfer programs such as Social Security. It is also widely used by state and local governments and the private sector to make cost-of-living adjustments.

The degree to which the CPI accurately indicates changes in the cost of living has been debated for many years. That debate has intensified recently, however, because of new evidence of an upward bias--that is, evidence that

the CPI grows faster on average than the cost of living for the overall population.

Measuring the cost of living is subject to a number of possible sources of bias. One reason the CPI may grow faster than the cost of living is that its calculation assumes that consumers do not change their buying patterns. The measurement of changes in the cost of living should reflect how changes in prices affect consumers' well-being. If consumers can change their buying patterns in response to rising prices in a way that helps to preserve their level of well-being, then some of the increase in prices does not raise their cost of living. Because the CPI does not account for how consumers can substitute one good for another, however, it tends to overstate the increase in the cost of living.

Bias can occur in numerous other ways as well. The choice of items or the weighting of the items that are sampled for price quotes may be biased toward items whose prices increase more rapidly, or the price quotes may fail to incorporate discounts. Changes in quality are another potential source of bias, one that is difficult to compensate for. In some cases, such as an increase in the durability of tires, adjustments in quality are relatively easy to make. Adjusting for changes in the quality of most of the goods and services sampled, however, is extremely difficult. Should the price of audio equipment be adjusted for changes in the quality of the sound? How should prices be adjusted for such changes in quality as an increase in banks' hours of operation, an airline's on-time record, or a physician's ability to make the correct diagnosis?

Although many analysts maintain that the CPI grows more rapidly than the cost of living, the size of the upward bias is subject to much debate. Some analysts feel the bias is relatively trivial, about 0.2 percentage points a year, whereas others feel the bias may be as much as 1.5 percentage points a year. This paper discusses the various arguments about the size of the bias. It first reviews quantitative studies of bias, then discusses other potential sources of bias in more general terms.

CHAPTER II

EMPIRICAL ESTIMATES OF MEASUREMENT BIAS

The empirical studies reviewed in this chapter attempt to determine the extent to which a number of possible types of bias may be affecting the consumer price index. The first two sections of this chapter focus on specific types of bias--commodity substitution bias and sample rotation bias. The remaining sections focus on specific commodities, such as pharmaceuticals and food, and may encompass a number of types of bias.

The difference in the focus of these studies raises the possibility of double-counting biases. For example, a study that finds a bias in the measurement of food prices may be detecting the same bias that the study of sample rotation detects. Therefore, in summing up the bias estimates, analysts must try to avoid such double-counting. To clarify how the studies add up to an estimation of overall bias, Table 1 summarizes the results discussed in this chapter.

COMMODITY SUBSTITUTION BIAS

A cost-of-living index should account for the way in which consumers may substitute one good for another to try to maintain their level of well-being when relative prices change. If, to use a common example, the price of beef rises faster than the price of chicken, consumers will buy less beef relative to chicken than they did before. The substitution of items whose prices have grown relatively slowly for items whose prices have increased relatively rapidly is called the commodity substitution effect.

By contrast, many price indexes, including the CPI, are essentially fixed-weighted price indexes in which the weights are determined by consumption patterns (the mix of goods and services people purchase--commonly referred to as the market basket) in an earlier base period (currently 1982-1984). These weights form the basis of the calculation used to aggregate the month-to-month changes in prices for the 207 basic categories (called "strata" by the Bureau of Labor Statistics) of goods and services into an overall index of price change. Fixed-weighted price indexes do not reflect changes in the mix of goods purchased over time, and therefore a fixed-weighted index that uses weights from a previous period tends to overstate increases in the cost of living.

TABLE 1. ESTIMATES OF THE RANGE OF UPWARD BIAS IN THE EMPIRICAL STUDIES

	Minimum	Maximum
Commodity Substitution Bias	0.1	0.3
Sample Rotation Bias	0.2	0.3
Prescription Drugs	0	0.1
Major Appliances	0	0.1
Auto Pollution Adjustment	<u>-0.1</u>	<u>0</u>
Net Upward Bias	0.2	0.8

SOURCE: Congressional Budget Office.

NOTE: Estimates of bias discussed in the text for food and apparel are included in those for sample rotation bias because those studies are probably measuring the same bias.

Analysts can also construct price indexes, called superlative indexes, that are better measures of price change for cost-of-living calculations than the fixed-weighted formula used for the CPI.¹ Updating such formulas is expensive and difficult. To do so, analysts must collect and have new information on both prices and spending patterns on a monthly basis. Superlative indexes can be used in retrospective studies, however, to estimate substitution bias in the official measure.

Two recent studies that used superlative indexes to estimate substitution bias found a bias of about 0.2 percentage points per year. One study, which used personal consumption data for 101 commodities for the 1959-1985 period, estimated the bias to be 0.19 percentage points per year.² A more recent study, using more detailed data for the 1982-1991 period, also found the commodity substitution effect to be about 0.2 percentage points per year.³

1. See W.E. Diewert, "Index Numbers," in John Eatwell, Murry Milgate, and Peter Newman, eds., *The New Palgrave Dictionary of Economics* (London: MacMillian Press, 1987), p. 77.
2. Marilyn E. Manser and Richard J. McDonald, "An Analysis of Substitution Bias in Measuring Inflation, 1959-1985," *Econometrica*, vol. 56 (July 1988), pp. 909-930.
3. Ana M. Aizcorbe and Patrick C. Jackman, "The Commodity Substitution Effect in CPI Data, 1982-91," *Monthly Labor Review* (December 1993), pp. 25-33.

A third study, which calculated the effect of more frequent updating of the market basket on the CPI, had similar findings.⁴ Although this study did not attempt to measure substitution bias directly, it provides indirect evidence of how the failure to account for changes in spending patterns can affect the size of the bias. The study indicated that using the 1982-1984 market basket boosted the measured change in prices for the 1989-1992 period by an average of about 0.2 percentage points a year from what it would have been if the market basket was updated every year.

SAMPLE ROTATION BIAS

Research by the BLS indicates that upward bias in the CPI may also result from the method used to combine price data on detailed items *within* the major categories of commodities when the sample of outlets (that is, stores, physicians' offices, restaurants, and the like) and items is changed.⁵ In particular, the price indexes for those categories in which the prices of items vary widely within subcategories of the major category (or stratum) are likely to overstate price increases significantly in the months following a change in the outlets and items sampled.

Ironically, this problem was an unintended side effect of an effort to improve the CPI in 1978. Before that time, the CPI was calculated as a fixed-weighted index between major revisions, which were usually conducted every 10 years or so. The sampled items and outlets were specified in great detail, and neither the outlets nor the items were changed except during major revisions to the survey.⁶ Therefore, new goods and services were brought into the sample infrequently.

In 1978, to better represent between major revisions the change in the mix of items and outlets that consumers actually use, the BLS instituted a procedure to rotate the sample within each stratum. Since then, about 20 percent of the outlets surveyed have been changed every year, opening up the

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4. Mary Lynn Schmidt, "Effects of Updating the CPI Market Basket," *Monthly Labor Review* (December 1993), pp. 59-62. The study only indicated how the price change measure would differ because of changes that occur for the 207 categories, and it only reweighted the categories at the national level.
 5. Brent R. Moulton, "Basic Components of the CPI: Estimation of Price Changes," *Monthly Labor Review* (December 1993), pp. 13-24.
 6. Obviously, some items or outlets would have to be dropped, or substitutions made, if the item was discontinued or the outlet closed, but the affected items and outlets did not constitute a major part of the surveyed items.

possibility of a total change of sampled goods and services every five years. Although the weights on the categories remain fixed, the specific items within the categories and their weights can change as the sample is rotated.

The 1978 innovation resulted in better selection of the items consumers actually purchase, but one aspect of the new procedure appears to have caused an upward bias in the CPI. The BLS study indicates that the CPI gives too much weight to goods whose prices are relatively low when first introduced and are therefore likely to increase more rapidly in the months following the rotation (see Box 1). This systematic overweighting of items that tend to have temporarily higher rates of price change probably overstates the annual rate of growth of the overall CPI by about 0.3 percentage points. This estimate is based on the difference, for the period from mid-1992 to mid-1993, between the growth rate as currently calculated and a growth rate that uses a weighting procedure that would not be subject to the weighting bias.

These conclusions are supported by other findings in the BLS study. The growth of the CPI for those parts of the survey that have recently undergone rotation is greater than the growth of the CPI for all other areas. In addition, the categories with the most volatile prices show the largest differences when the index is recalculated using a formula that minimizes the overweighting problem. The conclusions about the effect of sample rotation must be tempered, however, because the BLS study has not been subject to much academic review, and the estimate of the magnitude of the bias relies heavily on data for one year only. The conclusion of a bias of 0.3 percentage points should be considered tentative until more work can be done.

EMPIRICAL STUDIES OF THE CPI FOR PRESCRIPTION DRUGS

Studies of price indexes of prescription drugs suggest the CPI for drugs may be biased upward, though the effect on the overall CPI may be small. The two major reasons for possible bias are that the CPI may not adequately capture changes in quality and that the sample may not represent the actual patterns of drug expenditures. The problems with changes in quality occur because attributes of new drugs such as efficacy, side effects, and convenience of use are not tracked and because generic drugs are usually not treated as replacements for brand-name drugs. The sample may not adequately represent drug prices because current CPI methods do not reflect the high rate at which new drugs enter the market and the rapid increase in the market share of generic drugs after a patent for a brand-name drug expires.

BOX 1.

CAUSE OF UPWARD BIAS ASSOCIATED WITH SAMPLE ROTATION

Sample rotation, the updating of 20 percent of the stores and items that are sampled for the collection of price data in the consumer price index (CPI), results in a more representative and up-to-date sample of household purchases, but it may also cause an upward bias in the CPI.

Approximately two years before a sample is changed, the Bureau of Labor Statistics (BLS) conducts a point-of-purchase survey to analyze the shopping patterns of consumers in the area. That survey is used to select the stores the BLS field representatives will examine. Then, a few months before the sample will be rotated, the representative determines the specific item to be priced within a quite narrow category--for example, the representative is told to price apples, but he or she must determine the specific type of apple. The representative usually uses the outlet's sales records to select the specific item to be sampled.

The next step is to link the new items or stores to the old ones, and that process has two parts. First, the field representative collects price data for the new items for a short period before the data are actually used in the CPI. Then, when the item is included, the growth in the item's price can be compared with its own price history during that period, not with the price history of an item that could be quite different.

The second part of the linking process--and the one that is more important in addressing the issue of bias--is to determine the weight of the new item within its own category. That is done by first deflating the surveyed price back to the time of the point-of-purchase survey and then dividing that price into the total expenditure on the item at the time of the survey. That calculation yields an expenditure weight in constant dollars.

The BLS indicates that this procedure probably systematically gives a greater weight to items or stores that happen to have relatively low prices when they are included in the sample. If, for example, Baldwin apples were on sale at a particular outlet when new items or stores were rotated into the survey, the level of the deflated price of the apples at that outlet would be lower than the average price of all apples of that type, and the weight for that sample item would be correspondingly larger. (Dividing the expenditures on apples determined at the time of the survey by an artificially low price would result in a greater weight.) In addition, the price of an item on sale during the month in which it is brought into the sample is likely to rise more rapidly in the ensuing months to get back to the normal level of prices than items that were not on sale. Therefore, items or stores that will tend to have higher inflation rates after the sample has been rotated are systematically overweighted within each category.

Improvements in the quality of drugs are extremely difficult to measure and may be virtually impossible to embed in a monthly survey of prices. Even so, improvements are hard to ignore. A study that attempted to account for the changes in the quality of brand-name antiulcer drugs found that a price index that did not adjust for qualities that patients and doctors considered important increased by an average rate of 13 percent a year between 1977 and 1989, compared with a 6 percent increase for a quality-adjusted price series.⁷

The measurement of change in quality was also investigated in a study of antihypertensive drugs.⁸ The study found that the prices of 20 of those drugs were related to measures of quality such as the magnitude of the drop in blood pressure, intolerable side effects, and the percentage of patients who responded to the drug. The analysts who conducted the study stress its preliminary nature and note that they had to make numerous judgmental decisions in collecting the data, but they found that a price index that accounts for changes in quality increased about half as fast as an index that did not incorporate such changes.

Another possible source of bias stems from the treatment of generic drugs. The CPI may fail to track true quality-adjusted prices both because generic drugs are underweighted in the sample and because they are not treated as substitutes of brand-name drugs. Generic drugs are brought into the sample late, and once in the sample, the weight is unlikely to increase as fast as it should. Generic drugs account for more than half of all drug prescriptions that are filled, and they are likely to capture an increasing share in the future.

A study of the price behavior of two generic drugs indicates that the failure to treat them as substitutes for brand-name drugs causes a large upward bias in the measurement of drug prices.⁹ The study focused on the producer price index (PPI), but the results would probably also apply to the consumer price index. By directly linking the price of a generic drug to the price of the brand-name drug, the measured rate of price change for the two drugs studied is much slower. The price of one type of drug showed no

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7. Valerie Y. Suslow, *Are There Better Ways to Spell Relief? A Hedonic Pricing Analysis of Ulcer Drugs*, Conference Paper (Washington, D.C.: American Enterprise Institute, October 1993), p. 24.
 8. Ernest R. Berndt and Stan N. Finkelstein, *Price Indexes for Anti-Hypertensive Drugs That Incorporate Quality Change: A Progress Report on a Feasibility Study*, Working Paper No. 6-92, Program on the Pharmaceutical Industry, Sloan School of Management (Cambridge, Mass.: Massachusetts Institute of Technology, 1992).
 9. Zvi Griliches and Iain Cockburn, *Generic and New Goods in Pharmaceutical Price Indexes*, Discussion Paper No. 1664, Harvard Institute of Economic Research (Cambridge, Mass.: Harvard University, December 1993).

change over four years when only the price of the brand-name drug was used, but the price decreased about 30 percent when the generic was assumed to be a perfect substitute for the brand-name drug. In the other case, the brand-name price increased by 14 percent, whereas the price index that assumed perfect substitutability fell by 53 percent. The difference between the measured rates of price change is attributable to the lateness of the inclusion of the generics with too small a weight in the official calculation and to the failure of the official measure to capture the extent to which generics increase their market share in the years after their introduction.

The behavior of prices in the pharmaceutical industry emphasizes the need for basing the CPI on a representative sample of drugs. The price of many patented drugs increases rapidly when generic drugs become available, because the companies target consumers who are almost totally unresponsive to changes in price. Some manufacturers may feel that they can maximize their profits by raising prices when their patent expires, since generic drugs are going to capture a large part of the market even if the manufacturers of patented drugs lower their prices. Consumers (individuals or medical care providers) who are unaware of price increases, or who are indifferent because of arrangements with third-party payers, will continue to buy the patented drug even at the higher price. But other, more price-aware consumers have the option to buy the lower-price generic drug.

The pricing policies that drug firms follow when they introduce new drugs, whether patented or generic, are also a factor. The prices of many new drugs fall significantly in the first few years on the market. If the current price measures are slow to include new drugs with their proper weight, they will miss much of the initial price decline.

Another study that focused on the PPI indicates the possibility of upward bias in that measure because the sample of drugs is too limited.¹⁰ The pharmaceutical industry introduces new products at a high rate. For example, the Department of Health and Human Services added 3,048 new products to its list of drug products between 1982 and 1987, almost a 50 percent increase. In the study, a price index based on a larger, more representative sample of prescription drugs rose more slowly than the published PPI drug index. Using the same basic formula as the official PPI, the study concluded that prices increased an average of 6.9 percent a year over the 1988-1991 period in the broad sample, compared with 8.4 percent in the published data. Note that this index ignores new drugs introduced between 1988 and 1991; it tracks only

10. E.R. Berndt and P.E. Greenberg, *Price Growth of Prescription Pharmaceutical Preparations: An Update and Extension*, Discussion Paper No. 94-1 (Cambridge, Mass.: The Analysis Group, Inc., January 1994).

the prices of drugs that existed at the beginning of the period. When analysts calculated another price index that incorporated drugs introduced during that period, the average annual price change was 6.0 percent.

Even large overstatements of changes in drug prices would not have a large impact on the overall CPI, however, given the small weight (about 1 percent) that drugs have in that index. Therefore, an overstatement of drug prices of even 4 percentage points per year implies an overall CPI bias of only 0.04 percentage points. Some of the evidence indicates a greater overstatement of the changes in drug prices, so the effect on the overall CPI may be greater, but it is still unlikely to be large. Drug prices, however, play a larger role in the purchases of Social Security recipients, so any overstatement of drug prices would have to be taken into account if a specific price index was to be developed for that group.

OTHER EMPIRICAL STUDIES OF BIAS

A number of studies that focused on specific categories of the CPI have been published during the past 15 years. As mentioned earlier, many of these studies may be detecting a bias caused by sample rotation, so their estimates of bias cannot simply be added to those for sample rotation to arrive at an estimate of overall bias. Therefore, the possibility of double-counting the biases is discussed below.

Food and Gasoline

One study used two different approaches to examine the price changes for food and fuel in the CPI during the 1980s and found some upward bias.¹¹ But those empirical estimates are probably detecting sample rotation bias.

In the first approach, prices for items that were being dropped from the sample at the time of rotation were compared with prices of essentially identical items that were being brought into the sample. This method led to an estimate of an upward bias in the CPI for food of at most 0.25 percentage points per year for the period from January 1987 to June 1989. Similar results were obtained for gasoline, although the results were less conclusive.

11. Marshall Reinsdorf, "The Effect of Outlet Price Differentials on the CPI," in Murray F. Foss, Marilyn E. Manser, and Allan H. Young, eds., *Price Measurements and Their Uses* (Chicago: University of Chicago Press, 1993).

The second method compared the CPI data with the average-price data for the 1980s published by the BLS. Those data track the average price paid for a specific, representative type of good. The BLS uses dollar values for those data rather than index numbers, and the change in quality is minimal since a specific type of good is tracked continuously. One drawback of the data is the implicit assumption that quality does not change when new outlets enter the sample. For example, when the price of gasoline is tracked, the increasing importance of self-service outlets implies a lower quality of service, but the price of gasoline is not adjusted for that change.

The study found that prices in the average-price data grew more slowly than the prices in the CPI for all but 4 of the 52 food items studied, and the overall annual growth in food prices was 2 percentage points slower over the 1980s. For gasoline, the average-price data also indicated that price growth was 2 percentage points slower than reported in the CPI, but the study attributed over half of the difference to the change in the quality of service.

Growth in food prices is likely to be overstated in the CPI. The study of sample rotation bias indicated an upward bias for food prices, as did both methods discussed above. These studies are probably detecting the same bias, however, so the estimate of bias that was based on average-price data should not be added to the sample rotation bias.

The evidence does not imply that the measurement of gasoline prices is biased. This study found little bias when it corrected for change in quality, and the study of sample rotation also found little bias for gasoline prices.

Apparel

Apparel prices may currently be subject to an upward bias because of sample rotation bias discussed above. Before 1991, the BLS was concerned that measured changes in apparel prices may have been biased *downward* because the CPI treated some price changes as quality changes. The causes of the downward bias now appear to have been corrected, but the rotation bias may still be present.

Large increases in apparel prices tend to occur at the time the product is first offered for sale--that is, at the beginning of a season--and prices are then discounted toward the end of a season. The procedure the BLS used before 1991 to incorporate new apparel items into the CPI did not adjust for changes in quality in the month the good was introduced. Failure to make that adjustment resulted in an understatement of the increases in apparel

prices because it included the discounting but excluded the initial price increases.

A study estimated the amount of understatement by comparing the CPI with so-called hedonic indexes for two categories of apparel--women's coats and jackets, and women's suits. (A hedonic index tries to account for changes in quality by estimating the value of various characteristics of a good. See Box 2.)¹² The hedonic indexes were constructed using the checklist of characteristics with which the BLS field representatives identified the items to be sampled on a monthly basis. Although the results were not conclusive, this study indicated that the CPI significantly understated changes in apparel prices.

In 1991, the BLS began to use hedonic techniques to supplement its evaluation of price quotes in apparel. Commodity analysts use the information from the hedonic techniques to decide how to adjust apparel prices for quality over the season and as outlets and items in the sample change. Although problems probably remain in the quality adjustment of apparel prices, most of the downward bias has been eliminated.

Although the development of hedonic indexes has adjusted the source data on apparel prices for changes in quality, the source data was itself biased because of the sample rotation effect. The sample rotation study tentatively indicates an upward bias for apparel of almost 2 percentage points during the period from mid-1992 to mid-1993.

Household Appliances

A study that tracked changes in the quality of household appliances such as refrigerators, air conditioners, washers, and dryers found that the CPI overstated quality-adjusted price increases for these items between 1972 and 1983.¹³ Using issues of *Consumer Reports* and Sears catalogs, a researcher calculated alternative price indexes for appliances that took changes in quality into account. The study used both hedonic techniques and a method in which closely similar models were tracked over time.

12. Paul R. Liegey, Jr., "Adjusting Apparel Indexes in the Consumer Price Index for Quality Differences," in Murray F. Foss, Marilyn E. Manser, and Allan H. Young, eds., *Price Measurements and Their Uses* (Chicago: University of Chicago Press, 1993).

13. Robert J. Gordon, *The Measurement of Durable Goods Prices* (Chicago: University of Chicago Press, 1990).

For the 1972-1983 period, the price increases in the CPI data were similar to the quality-adjusted indexes for some of the appliances but vastly overstated price increases for others. The maximum estimate of the overstatement of price change for appliances was about 4 percentage points a year. Given that those goods account for about 1 percent of the items in the CPI, these figures imply that the maximum effect on the overall CPI of understating changes in quality would be less than one-tenth of a percentage point. The results of this study may not be applicable to the period since 1983, however, and therefore even this estimate is extremely tentative.

Motor Vehicles

In contrast to the prices of most durable goods, prices of motor vehicles in the CPI may be biased downward. Because the BLS considers the mandatory safety and pollution control devices as improvements in quality, it adjusts list prices downward to account for the cost of those devices when they are introduced. For a cost-of-living index, however, at least some of those changes should be treated as price increases.

Since the 1960s, the BLS has adjusted the list prices of new models for changes in quality. The bureau first looks at the list of potential changes in quality at the outset of each model year and decides which should be considered actual quality changes (as opposed to styling changes or minor alterations). It then uses cost information from producers to determine how much each change in quality contributed to the price of the new model. In some cases, the BLS has adopted the full cost claimed by the manufacturer. In other cases, it has used the lowest cost claimed by the various manufacturers instituting a similar improvement. In still other cases, when changes in quality have been radical, the quality-adjusted change in a model's price might also reflect information from the change in prices of models that experienced less radical changes.

The safety mandates might properly be included in the quality adjustment, largely because the benefits accrue directly to the consumer, because consumers appear to have demanded some of the safety changes ahead of the mandates, and because the consumer may be able to weigh the costs and benefits. Pollution control, however, benefits society at large, and there is no indication that consumers would have valued it at the full cost of the improvement. Although the data are not complete, the BLS's adjustments for

BOX 2.
ACCOUNTING FOR CHANGE IN QUALITY

Whenever new items are brought into the consumer price index (CPI) sample, potential changes in quality have to be addressed. New items can enter the sample in two ways. If an item that a field representative from the Bureau of Labor Statistics (BLS) has been tracking at a particular outlet is no longer carried by the outlet, the representative will try to find a substitute item at the same outlet that best matches the characteristics of the item that was being tracked. Substitutions are found for roughly 3 percent of the nonshelter price quotes each month. New items can also enter the sample as part of the sample rotation process discussed in the text.

When substitute items are introduced, commodity analysts decide how much of the change in the price of the new item may be attributable to a change in quality. The analysts use four basic methods. They may decide the item is of the same quality, in which case the prices are directly compared--that is, the change in price from the old to the new item is used in the CPI. They may decide the prices cannot be directly compared and instead use "overall mean imputation" pricing. In imputation pricing, the price series of the old item is dropped, the price series of the new item enters the survey, and the quality-adjusted change in the price in the month the item was brought into the sample is assumed to be the same as the average price change for other goods in its category and geographic area. In a minority of cases--primarily autos--the analysts use a third method in which their decisions are guided by detailed analysis of the cost of modifications.

The fourth method uses hedonic indexes. The creation of hedonic indexes assumes that goods can be viewed as bundles of characteristics that consumers desire. With such indexes, analysts try to match qualities of the new item with those of the old to estimate the change in the quality-adjusted price. An example of a hedonic index that has been used in the national income and product accounts for many years is the price index for residential construction. Analysts track the specific characteristics of the residential units under construction--such as the number of rooms, the square feet of interior space, the number of fireplaces, and whether or not the unit has central air conditioning or a garage--and then estimate a regression equation in which they attribute variations in sales price among units to the various characteristics. Using this method, they can impute prices for the characteristics. Therefore, the price of a new set of housing units that has different characteristics from the old set can be compared characteristic by characteristic to determine how much of the change is true price change and how much stems from a change in quality.

BOX 2. CONTINUED

Hedonic techniques can provide additional information on how to adjust prices for changes in quality, but they also have a number of weaknesses. They hold constant only the characteristics that researchers have identified as the most important and that can be measured. If the researchers have failed to identify a characteristic that is important to consumers, the hedonic index will be biased. Hedonic indexes are also somewhat judgmental, both in the selection of characteristics and in the interpretation of the statistical estimation of the indexes. In addition, the qualities of a good that consumers value change over time, so hedonic specifications often have to be updated. For example, heavier automobiles were more desirable before the sharp increase in oil prices in the 1970s, so hedonic indexes calculated in the 1960s that used a car's weight as a positive characteristic were less valid during the next decade.

None of the four methods discussed above, however, is used when items enter the sample through sample rotation. The prices of the new items that are rotated into the sample are brought into the index by a fifth method called overlap pricing. The prices of the new items are sampled in the month before actually being brought into the sample, and then the rate of change in price of the new item is used to calculate the CPI in the month the new item is introduced to the sample.

The BLS's procedures can sometimes over- or understate changes in prices. If prices are assumed to be directly comparable and the replacement good is of higher quality than the discontinued item, the CPI will overestimate the true, quality-adjusted price change. Similarly, if the replacement good is of lower quality, the CPI will underestimate the price change. The same problem could occur when mean imputation pricing is used. If the replacement good is of such higher quality that the increase in its price over the old good when adjusted for differences in quality is less than the price increase of other goods in its category, the CPI will overstate the price change. Conversely, if sellers use the minor modification as an opportunity to raise the quality-adjusted price more than the mean imputation procedure assumes, the price increase will be understated. Similar problems can occur for overlap pricing techniques.

improvements in federally mandated pollution control devices deducted less than 0.05 percentage points per year from the growth of the CPI during the 1980s. Therefore, the pollution adjustments have probably had little effect on the overall growth of the CPI.

Housing

The treatment of housing costs in the CPI has been a subject of controversy for many years. That controversy led to two significant revisions to the housing component during the 1980s, and the current housing measure is unlikely to have a significant bias.

During the 1970s and the early 1980s, the CPI measure of imputed rent for homeowners—that is, what homeowners would have had to pay to rent the homes they own—tracked the cost of buying rather than renting a house. The measure would rise during periods in which mortgage rates were increasing and would fall when rates were dropping. The housing costs of the vast majority of homeowners would not be affected by rising interest rates, however, since few people would buy a home in any given year. Therefore, the CPI was clearly not tracking those costs adequately. Note that this problem did not cause a long-term bias in the measure of housing costs, only excessive volatility. In 1983, the BLS corrected this problem by basing the imputed rent on a survey of actual rents paid for houses similar to those that households own.

Another revision of the housing component of the CPI was spurred by the failure to account properly for depreciation of rented housing units. By underestimating the physical depreciation of housing units, the CPI understated the quality-adjusted increases in housing prices. Indexes of shelter costs were estimated to be biased downward by as much as 0.3 percent to 0.4 percent annually.¹⁴ In 1988, however, based on a series of studies, the BLS corrected this problem.

14. William C. Randolph, "Housing Depreciation and Aging Bias in the Consumer Price Index," *Journal of Business and Economic Statistics* (July 1988).

CHAPTER III

OTHER POTENTIAL SOURCES OF MEASUREMENT BIAS

Other potential sources of bias could be adding to or offsetting the bias found in the empirical studies. Three potentially important causes of bias that have not been subject to empirical tests are the introduction of new goods, the problems of adjusting for the quality of medical care (other than pharmaceutical drugs), and the possibility of bias in the measurement of prices for services such as banking and insurance. A fourth potential source of bias discussed here--the possibility that the overall cost-of-living index does not reflect the appropriate weights for medical care--is a definitional rather than an empirical question. It illustrates the potential difficulty in determining which expenditures should be counted in a cost-of-living index.

NEW GOODS

The introduction of new goods presents difficult problems in measuring prices. The "new goods" problem is an extreme version of the quality-adjustment problem discussed in Chapter II. Should electronic calculators introduced in the early 1970s be considered substitutes for mechanical adding machines or slide rules? Should videocassette recorders (VCRs) and movie rentals be considered substitutes for movie theater tickets? And should compact discs be considered substitutes for phonograph records or tapes? The consumer price index currently does not consider new goods to be substitutes for the goods they are partially or completely replacing.

Although no empirical studies have directly addressed the question of the overall degree of new-product bias in the CPI, theoretical estimates are possible. Their usefulness depends on the validity of various assumptions, but one can get a sense of the scope of the problem by using approximations regarding the pattern of price changes for new goods and the proportion of new goods in the total amount of goods consumed. Theoretically based estimates, however, are rough and subject to large errors. Initial, theoretically based estimates of the size of the substitution bias, for example, were larger than those found in subsequent empirical work.

With those caveats in mind, the theoretical exercise is as follows. To take an extreme example first, assume that the price of a new good falls by one-half in the first year and by one-half again in the second year, and that the quantity of the good consumed doubles in the second year to equal 1

percent of total consumption. Under those assumptions, the index formula used for the CPI overstates the increase in the cost of living (that is, increases faster than a superlative index) between the second and the third year by 1 percentage point. If the example is changed so that the share in consumption of the new good in the second year is 5 percent, then the overstatement is 4.5 percentage points.¹

Few goods experience such dramatic price declines, but the theoretical example is relevant to some goods. The price of VCRs, for example, fell from about \$1,500 in 1980, when the models that had programming capability first became popular, to about \$600 five years later and below \$300 a few years after that. The share of video equipment excluding televisions (that is, VCRs, camcorders, and film equipment) in total expenditures was about 0.2 percent in 1993 compared with virtually zero in 1980 (the year before such equipment was available for the home). Applying the theoretically estimated overstatement of the cost of living from the example in the previous paragraph to the situation for VCRs indicates that failing to track VCRs would cause the CPI to overstate the increase in the cost of living by about 0.02 percent a year over the past 10 years.

Although the published CPI missed the effect of the initial introduction of VCRs on the cost of living, it did reflect some of the subsequent price change. The advantage of rotating the sample each year is that it brings new products such as VCRs into the sample, though more slowly than the rate at which they were accepted by households, and therefore the CPI captures some of the price decline of the first 10 years.

Thousands of new products and services are introduced every year, and though few are as significant as VCRs and perhaps even fewer experience the pricing behavior and market penetration assumed in the theoretical example, the example still provides some basis for estimating bias. A number of the products introduced during the 1980s were similar to VCRs in their price history and acceptance by consumers. They include computers, camcorders, communication equipment, audio equipment, microwave ovens, some types of photography equipment, electronic toys, and digital watches. These goods account for about 1 percent of spending in the CPI. Numerous other new products and services did not capture market share as quickly as VCRs and did not experience such rapid declines in price but are still important for estimating the potential bias for new goods. Examples include convenience

1. See W.E. Diewert, "Index Numbers," in John Eatwell, Murry Milgate, and Peter Newman, eds., *The New Palgrave Dictionary of Economics* (London: MacMillan Press, 1987), p. 77.

foods, cable television, various small electrical appliances, and some sports equipment; this category is also small, with about a 2 percent share.

To provide a rough estimate of the high end of the range of new-product bias in nonmedical goods and services, one could assume that as many as half of the products that make up the 1 percent of expenditures have prices and market shares that behave like those of VCRs. This assumption would imply, by the reasoning above, that the maximum bias for VCR-like new products would be on the order of 0.1 percentage point a year. One could also assume that half of the goods in the second category are new goods, which would imply that the theoretical example given above overstates the bias of those products because their prices do not fall as rapidly as those of VCRs once the good has been introduced. At most, the new-product bias of the goods in this category would be about 0.1 percentage point a year. Therefore, a high-end estimate of bias resulting from the introduction of new items would be on the order of 0.2 percentage points a year, if there is no sample rotation. Given sample rotation, the estimate would probably overstate the bias, but it is difficult to quantify how much the rotation procedure would lower the bias.

MEDICAL CARE

Fundamental problems are associated with measuring quality-adjusted prices in medical care. One major problem is the question of what to measure. Should the index track the costs of curing illness or the prices of treatments, such as a course of antibiotics, surgery, or an office visit to a physician? Consumers' welfare is related to cures, not treatments per se, but the current CPI tries to measure the price of treatments. If a drug took the place of surgery for a specific condition, greatly reducing the price of a cure, the CPI would not reflect the reduction in the price of that cure.

Another major problem is the question of how to treat new goods. If children today get fewer cavities than in the 1950s because of fluoride additives to the water and the development of durable substances to coat teeth, how can those improvements be reflected in the quality-adjusted price of dental care? Similarly, how can treatments such as the use of lasers that prevent the loss of sight be brought into the price index when no comparable treatment or cure was previously available? How does one value additional years of sight?

Few empirical estimates have addressed these problems, and this paper does not quantify any potential bias stemming from changes in the quality of

medical care. The studies of the pharmaceuticals reviewed in Chapter II provide some insight into the scope of the problem, but little other empirical work has been done. Therefore, this section simply discusses three areas of medical care to illustrate the complexity and size of the problem of quality adjustments for that care.

CT Scanners

A study of the prices of computerized tomographic X-ray machines (CT scanners) highlights the difficulties with measuring price when technology is changing rapidly, as it has in many areas of medicine.² The average price of a CT scanner increased by about 160 percent between 1973, when they were introduced, and 1982. If instead one uses a price index that adjusts for changes in quality using four characteristics (resolution, scan time, image reconstruction time, and ability to examine just the head or the entire body), the price falls by 72 percent over that period. Furthermore, a third measure that attempts to model the benefit to the consumer of the different improvements indicates that the price has fallen by 99.9 percent.

The wide variety of results for CT scanners indicates the problems with developing indexes for medical care prices. Improvements in quality create a potential for a large upward bias in the CPI relative to a true cost-of-living index.

Physicians' Services

The improvements in diagnostic techniques such as CT scanners and in treatments should also be reflected in prices for physicians' services. From the development of nonlaboratory tests for strep infection to better surgical procedures, technical change has greatly augmented the benefits to the consumer of a physician's services. The Bureau of Labor Statistics, however, is able to distinguish only a few characteristics that reflect the quality of an office visit. For example, if a standard physical performed in the office being sampled is upgraded to include a new test, the BLS can adjust the price series for that change. But changes in quality that are less easily identified and potentially much more important, such as the ability to make the correct diagnosis quickly, cannot be easily incorporated into the price series. For those reasons, the CPI may fail to account for improvements in quality.

2. M. Trajtenberg, *Economic Analysis of Product Innovation: The Case of CT Scanners* (Cambridge, Mass.: Harvard University Press, 1990).

Many patients, however, complain that the quality of medical care has fallen because physicians spend less time with them than before, or more patients are prevented from seeing the same physician regularly. Quality can suffer not only because of patients' unease and discomfort with the more assembly-line nature of health care but also because the quality of diagnosis and subsequent care can be adversely affected when the physician does not know the patient well.

In the absence of studies of these questions, however, it is impossible to determine whether the CPI for physicians' services is biased upward or downward.

Dental and Eye Care

Technological change and improvements in quality have been rapid in dental and eye care as well. Dental care has improved with the development of coatings for children's teeth, improved equipment and techniques, better anesthetics, new materials for fillings and caps, and better X-ray equipment. Eye care technology has also changed rapidly. Improvements in cataract surgery have made the procedure more effective, better able to cure a wider variety of conditions, and easier for patients. Laser surgery can now delay or prevent loss of sight in formerly untreatable cases; contact lenses have become easier to fit and wear for extended periods. Service has also improved: consumers can now have their eyes examined and eyeglasses made at the same location, and the eyeglasses can be made in one hour.

Again, none of these developments are accounted for in the medical care component of the CPI, and quantitative estimates of the importance of such omissions are unavailable.

NONMEDICAL SERVICES

Other areas in which the CPI may overstate price increases but for which no empirical work is available are in services such as banking and transportation. Banking services have improved with the advent of automated teller machines (ATMs), faster loan processing, telephone transfer of funds, and the like. The possible overstatement of price increases for transportation services results primarily from a failure to fully track discounts for airfares and from methodological problems with calculating the cost of auto insurance premiums.

Although most of those problems are difficult to address, the problem of auto insurance may be easier to correct. The BLS currently uses the entire premium paid for auto insurance to calculate the price increase, and that may create an upward bias. If the value of claims increases--perhaps because greater congestion results in more collisions or because repair costs or thefts increase--insurance companies would tend to raise premiums for ostensibly the same coverage. However, insofar as the expected value of the benefits that would flow from the policy is higher (since the likelihood of collision or theft has increased), the quality of the policy would increase in line with the higher premiums. The CPI should therefore not reflect a price increase that stems from that source.³

The BLS may change the treatment of auto insurance to follow that used for medical insurance. Under that method, the BLS would allocate only the pure insurance part of the premium (essentially the administrative costs of handling the insurance) to the category of auto insurance. The bulk of consumers' expenditures on auto insurance premiums would be allocated to those goods and services that the insurance companies pay for when claims are made--for example, auto body repair, medical costs, legal fees, rental cars, and lost wages. This procedure would reduce the possibility that the steady increase in auto insurance premiums is causing an upward bias in the CPI.

SPECIAL PROBLEMS IN SELECTING A WEIGHT FOR MEDICAL CARE

Measurement of the cost of living is affected by the choice of the expenditure shares, or weights, in the CPI, and the appropriate weighting for medical care is not obvious. The current weight for the personal consumption of medical care is about 7 percent, a figure that reflects households' out-of-pocket costs for medical care. But the CPI could also reflect total consumption of medical care, including that paid for by government (through taxes) and the part of medical insurers' payments to providers that is financed by employer-paid insurance premiums. The weight would then be 15 percent. If the broader definition is more appropriate for a cost-of-living index--and there are reasons to believe it is--then the current weighting would bias the growth of the CPI downward, assuming that medical care prices were otherwise measured correctly.

3. Paul A. Armknecht and Daniel H. Ginsburg, "Improvements in Measuring Price Changes in Consumer Services: Past, Present, and Future," in Zvi Griliches, ed., *Output Measurement in the Service Sectors*, vol. 56 of *Studies in Income and Wealth* (Chicago: University of Chicago Press, 1992), p. 136.

The 7 percent weight that the CPI now uses includes all medical care that is paid for directly by households and the employee's cost of medical insurance premiums. Including medical insurance premiums introduces some distortion, since households' decisions about how much medical insurance to buy is affected by their employment and the existence of government health programs, but the 7 percent weighting essentially captures the share of total consumption that consumers directly allocate to medical care.

The larger, 15 percent weighting has some merit, however, in that increases in health care prices will ultimately affect households adversely in more ways than just higher out-of-pocket costs. The effects could be higher costs in the form of higher taxes, slower growth of nonhealth compensation (that is, wages), or lower benefits (curtailment of Medicare coverage, increased deductibles, and so on). In this sense, consumption of medical care should be broadly defined to include the employers' share of medical insurance premiums and government outlays for health care.

The interaction between federal programs and private medical costs further complicates the weighting decision. Out-of-pocket medical insurance premiums have been growing faster in the CPI than they would have in the absence of cost controls on Medicare and Medicaid. When the federal government fails to reimburse health care providers for the full cost of the service, the providers try to recoup the difference by increasing the costs to their private-sector patients. One study indicates that Medicare reimbursement in the early 1990s paid for about 90 percent of the costs of covered services, compared with full reimbursement during the mid-1980s.⁴ In essence, the price index for out-of-pocket costs of medical care increased faster than the price index for Medicare during that period because of cost shifting. A more inclusive definition of medical care consumption--that is, the larger weighting--would avoid such distortions.

4. Congressional Budget Office, *Responses to Uncompensated Care and Public-Program Controls: Do Hospitals 'Cost Shift'?* CBO Paper (May 1993).

CHAPTER IV

MEASURING THE COST OF LIVING

FOR SUBGROUPS OF THE POPULATION

One aspect of the potential mismeasurement of the cost of living is the appropriateness of the measure for certain subgroups of the population. In general, the relevance of a cost-of-living index for a specific subgroup is related to the degree it reflects the spending patterns of that group. The regularly published consumer price indexes--the index for all urban consumers (CPI-U) and the one for urban wage earners and clerical workers (CPI-W)--reflect the spending patterns of 80 percent and 32 percent of the population, respectively. Therefore, they are not necessarily accurate indicators of changes in the cost of living for groups other than those they were designed to represent.

The problems associated with measuring the cost of living for subgroups of the population can be illustrated by examining an experimental index for the elderly that is published at various intervals by the Bureau of Labor Statistics.¹ The subgroup for this index consists of those households for which the reference person in the consumer expenditure survey is at least 62 years of age. Note that this subgroup is not the same as the Social Security population, since many people who are 62 and over are not beneficiaries of the Social Security system, and many people younger than 62, such as surviving spouses and dependent children, receive Social Security payments.

The index is considered to be experimental for a number of reasons. First, the relatively small sample size implies that the sampling error will be larger than that for the regularly published CPIs. Second, the index is based not on specific surveys of the outlets and items that the elderly use but on the point-of-purchase survey for the all-urban population. Finally, the index does not reflect the special prices available to senior citizens, which may distort the growth rate of prices for the elderly.

The experimental index for the elderly increased more rapidly during the 1980s and early 1990s than either the CPI-U or the CPI-W. Between December 1982 and December 1993, the experimental index rose at an average annual rate of 4.0 percent, compared with 3.7 percent for the official CPI-U and the 3.5 percent for the CPI-W.

1. Nathan Amble and Ken Stewart, "Experimental Price Index for Elderly Consumers," *Monthly Labor Review* (May 1994), pp. 11-16.

The most important factor in the rapid growth of the price index for the elderly was the larger weight for medical care.² Despite their coverage under Medicare, the elderly had proportionately higher out-of-pocket medical expenses during the 1982-1984 base period because they were less likely to have employer-provided medical care than were the CPI-U and CPI-W populations. In addition, the elderly spent proportionately more on those components of medical care, such as physicians' visits, for which prices rose the most rapidly.

The importance of the weighting of medical care raises additional questions about the usefulness of the experimental index as a measure of the cost of living for the elderly. Given the sample's small size and the fact that it is not representative of the consumption patterns of the elderly, using the experimental index as a cost-of-living index for that group would be problematic. In addition, the likelihood that increases in medical care prices have been overstated, perhaps by a great deal, further undermines the usefulness of the experimental index. From the studies of prescription drugs and the potential problems that measuring prices present for other aspects of medical care discussed above, medical care prices have probably grown less rapidly relative to all other prices than the current data indicate.

Two other issues are related to the development of cost-of-living indexes for specific demographic subgroups. First, spending patterns within particular subgroups might vary greatly during the base period, and that would undermine the validity of a subgroup index.³ Second, some subgroups may be better able or more willing to change their spending patterns in response to changes in relative prices than others, so the substitution bias of the fixed-weighted index would not be the same for all subgroups. One study noted that "subgroup indexes defined on a priori grounds (or for policy reasons alone) may perform less well as representative cost-of-living measures than the aggregate price index."⁴

Although this discussion has focused on potential mismeasurement of the cost of living for the elderly, the general issue of mismeasurement applies to

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2. The experimental index for the elderly has larger weights than either the CPI-U or CPI-W for housing and medical care, and smaller weights for food, transportation, apparel, entertainment, and other goods and services (such as education, tobacco products, and personal care).
 3. R.P. Hagemann, "The Variability of Inflation Rates Across Household Types," *Journal of Money, Credit, and Banking*, vol. 14 (1982), pp. 494-510.
 4. Mary F. Kokoski, *Consumer Price Indices by Demographic Group*, Working Paper No. 167, Bureau of Labor Statistics (April 1987), p. 10.

other subgroups as well. Because empirical work is extremely limited in this area, no conclusions can be drawn about how much the increase in the cost-of-living for subgroups may differ from the growth of the CPI. Clearly, this is another area that requires further study.

CHAPTER V

IMPLICATIONS OF MEASUREMENT BIAS

Measurement biases in the consumer price index for all urban consumers may have significant effects on perceptions of growth and welfare and on the federal budget. Real measures of economic output, wages, and the like are calculated by dividing nominal measures, such as the value of televisions sold or the hourly wage, by an appropriate price index. If the growth in the price index is biased upward, the real measures will be biased downward. In addition, by affecting the indexation of some outlays and personal income tax revenues, any overstatement in the CPI affects the federal budget and may result in a redistribution of wealth that was not intended by policymakers.

EFFECT ON MEASURES OF GROWTH IN GDP, PRODUCTIVITY, WAGES, AND POVERTY

Because some of the detailed price series that the CPI comprises are used to create measures of real spending on personal consumption in the national income and product accounts (NIPAs), the accuracy of the measurement of real growth in consumption, and, consequently, in gross domestic product (GDP) will be affected by measurement bias in the components of the CPI. Similarly, since most measures of productivity growth use the GDP data, measures of productivity will also be affected.

Real GDP Growth

The effects of one of the biases of the CPI, the commodity substitution bias, would not carry through fully to the measurement of real GDP. The calculation of GDP uses relatively detailed CPI components, so some of the shifts in the consumption mix that are not captured in the fixed-weighted CPI may already be incorporated into the calculation of real consumption.

How does overstating the cost of living affect measures of real growth in GDP and consumption? Assuming an overstatement in the CPI of, say, 0.5 percentage points per year, real GDP growth would be biased downward by about 0.2 percentage points. That is, a measure of real GDP that more properly accounted for price changes would have grown by 0.2 percentage points more per year on average. Similarly, real growth in consumption in the NIPAs would be understated by 0.3 percentage points per year. The overall

increase in real per capita GDP between 1979 and 1993 is currently reported to be 18 percent. If the CPI had been overstating price change by 0.5 percentage points a year for that time, then a better estimate of the growth in per capita GDP for that period would be about 21 percent.¹

Productivity Growth

Since GDP data are used to calculate productivity, a CPI bias of 0.5 percentage points per year would have a similar effect on the measurement of productivity growth. Labor productivity would have grown by about 1.3 percent annually between 1979 and 1993 rather than the reported 1.1 percent.

As currently measured, productivity grew more during the 1950s and 1960s than in subsequent years, and economists have been hard pressed to explain the slowdown. If it could be shown that the CPI had a greater upward bias in recent decades than in the early postwar years, the productivity slowdown might be partially explained as a problem with measuring prices. For example, if the pace of changes in quality or the introduction of new goods has accelerated or if the increased share of consumption allocated to services combined with rapid change in the provision of services has caused a larger upward bias in recent decades, then measured growth in productivity would be biased downward more in that period than in the 1950s and 1960s. In addition, as discussed above, the procedures introduced for the CPI in 1978 may have resulted in a greater upward bias in later years. There is no direct evidence, however, that a change in bias has occurred, and in fact some tentative evidence indicates that the bias was greater in the early postwar years. A study of price bias for selected consumer durable goods for the 1947-1983 period indicated a greater upward bias in the 1947-1960 period than in the 1973-1980 period.²

Real Wage Growth

Since the CPI is used as a deflator for measures of real growth in wages, such measures are biased downward by an upward bias in the CPI. Using the

1. Other price indexes that are used to calculate real investment, government spending, and so on may also have biases that affect the measure of real GDP growth, but this paper focuses only on the CPI. See, for example, Mark A. Wynne and Fiona Sigalla, *A Survey of Measurement Biases in Price Indexes*, Research Paper No. 9340 (Dallas: Federal Reserve Bank of Dallas, October 1993).

2. Robert J. Gordon, *The Measurement of Durable Goods Prices* (Chicago: University of Chicago Press, 1990), p. 23.

employment cost index for private-industry workers as the measure of nominal wages, real wages have grown less than 1 percent over the entire 1980-1993 period.³ If the measurement bias was 0.5 percentage points per year in the CPI, however, a better estimate of real growth in wages for that period would be 7 percent. The corresponding figures for real growth in compensation (wages plus benefits) would be 7.6 percent and 14.6 percent.

Poverty

The official definition of the poverty line may also be slightly distorted by a bias in the CPI, though the distortion is probably not significant. The increase in the poverty threshold is based on the increase in the overall CPI. The poverty line for a family of four in 1993 was \$14,763--99 percent above the 1979 level because the CPI increased by 99 percent between 1979 and 1993. If the CPI overstated the change in consumer prices by 0.5 percentage points a year during that period, then the poverty line would have increased by slightly less--about 92 percent--and the level in 1993 (assuming no change in the 1979 figure) would have been \$14,236, not \$14,763.⁴

EFFECT ON FEDERAL OUTLAYS AND REVENUES

Federal outlays and revenues are affected by the reported growth rates of the CPI. The table below shows how an overstatement of 0.1 percentage point in the CPI would affect the federal deficit through 1999. Even a bias of 0.1 percentage point, if it continued for five years, would push up the federal deficit by \$4 billion in the fifth year through its effect on indexed programs and tax brackets. A larger bias would affect the deficit proportionately. A bias of 0.5 percentage points, for example, would imply a \$20 billion effect on the deficit by 1999.

3. The CPI measure that uses a consistent definition of home ownership throughout this period (the CPI-U-X1) was used for these calculations.

4. There are many other reasons to argue that the measurement of the poverty threshold is too high or too low, but this paper is concerned only with the effect of a bias in the CPI.

(By fiscal year, in billions of dollars)

	<u>1995</u>	<u>1996</u>	<u>1997</u>	<u>1998</u>	<u>1999</u>
Personal Taxes	0.2	0.5	0.8	1.3	1.9
Increase in Outlays	<u>0.3</u>	<u>0.7</u>	<u>1.2</u>	<u>1.7</u>	<u>2.3</u>
Increase in the Deficit	0.5	1.2	2.0	3.0	4.2

Social Security accounts for three-quarters of the effect on indexed federal outlays shown in the table. Three other programs together account for about 20 percent of the impact--Supplemental Security Income, Military Retirement, and Civil Service Retirement. The remaining programs included in this estimate are Railroad Retirement, veterans' compensation and pensions, the Federal Employees' Compensation Act, and the retirement programs of the Foreign Service, Public Health Service, and Coast Guard. Programs whose outlays are partially related to subcategories of the CPI--such as food stamps, child nutrition, and Medicaid--are not included in the estimate because a correction for any mismeasurement of the aggregate CPI would not necessarily affect them.

The budgetary effect of any overestimate of changes in the cost of living highlights the possibility of a shift in the distribution of wealth. If the CPI has an upward bias, some federal programs would overcompensate for the effect of price changes on living standards, and wealth would be transferred from younger and future generations to current recipients of indexed federal programs--an effect that legislators may not have intended.

EFFECT ON MONETARY POLICY

A consistent overstatement of changes in the cost of living in the current CPI is unlikely to have much effect on monetary policy. The main reason is that monetary policy is primarily concerned with incremental changes in inflation rather than achieving a particular target for inflation. Therefore, a bias, if it is fairly constant, would not affect policy to any significant degree. Monetary policy may be affected slightly by mismeasurement, however, because an unknown bias creates some uncertainty about inflation. In addition, a bias may affect fiscal policy, which in turn affects monetary policy.

Although monetary policymakers often cite the growth in the CPI as a reason for tightening or loosening monetary policy, they are well aware of the measurement problems. For example, in testimony before the House Committee on Banking, Finance and Urban Affairs on February 14, 1994, the

Chairman of the Federal Reserve Board cited studies that indicated that the CPI probably overstates the increase in the cost of living by at least 0.5 percentage points a year. He also noted that some researchers felt the overstatement was as high as 1.5 percentage points.

Monetary policy's broader view is another reason why it is unlikely to be affected by any bias in the CPI. Policymakers' goals for inflation usually refer to price changes for the entire economy, not just consumer prices, so the CPI is not the only price measure used in formulating policy.

The indexation of federal programs to the CPI may, however, indirectly affect monetary policy slightly by reducing the constituency for curtailing inflation. If recipients of benefit programs are overcompensated because the CPI is biased, it may be more difficult to adopt policies to contain inflation because not only are a large number of people partially insulated from the adverse affects of inflation but some may actually benefit from it.

CHAPTER VI

ISSUES RELATED TO REVISING THE CPI

The Bureau of Labor Statistics plans to introduce some revisions to the consumer price index in January 1995, as well as conduct the customary 10-year revision in 1998. In addition, the BLS may publish an experimental version of the CPI in 1995 that will correct for the sample rotation bias. Given the pending major revisions to the CPI and the development of a new index, some of the issues addressed in this paper are likely to receive a wider hearing in the near future.

Regardless of what decisions are made about revising the CPI or developing a separate cost-of-living index, the credibility of both the process and the final product should be maintained. The CPI is widely used, and a major reason for its acceptance is its quality. A reliable index is needed so that individuals, firms, and the government will be willing to enter into long-term contracts that are indexed for price change. Such contracts enable people to insure against unexpected changes in prices. By reducing that uncertainty, the index allows the economy to function more efficiently and the country to maintain a higher standard of living. Therefore, policymakers should proceed cautiously in mandating changes to the CPI or changes in the formulas used to calculate the index.

PLANS FOR REVISIONS TO THE CPI AND DEVELOPMENT OF AN EXPERIMENTAL INDEX

The BLS will introduce some revisions to the CPI in January 1995 that are likely to reduce bias. One of the revisions addresses the effect of sample rotation on the measurement of food prices. Since most of the sample rotation bias occurs in the months immediately after the rotation, the BLS will delay the use of the food price data from the new sample. This will reduce the sample rotation bias.

The BLS will also revise its procedures for pharmaceutical drugs in January. A greater effort will be made to consider generic drugs as substitutes for patented drugs where appropriate. That could have a major effect on the measurement of changes in drug prices.

The BLS's current plans call for a major revision to the CPI, the regularly scheduled 10-year revision, in 1998. At that time the market basket

will shift to a 1993-1995 base period, and the consumer expenditure surveys for those years will be used to determine the expenditure weights for the 207 major categories of goods and services. The commodity substitution bias will be somewhat smaller after the introduction of the updated market basket, but some substitution bias will probably persist.

The BLS is also considering publishing an experimental CPI, starting sometime in 1995, that would correct for the bias caused by rotating the outlets and items in the sample. Although the January 1995 revisions will address the rotation bias for food, the experimental index would cover other items as well. The experimental index would probably be calculated for a short historical period and then be published monthly along with the existing index.

SHOULD THERE BE SEPARATE INDEXES FOR MEASURING THE COST OF LIVING AND INFLATION?

Changes in the CPI are used as an indicator of changes in both inflation and the cost of living. Although these terms are commonly viewed as synonymous, there are important distinctions. Inflation--persistent growth in the general level of prices--is a more inclusive term. It takes into account the change in a wide variety of prices, not just those for consumer goods. In addition, it does not refer to transitory price changes, changes in relative prices, or a one-time increase in the level of prices.

In contrast, the measurement of changes in the cost of living focuses on how price changes affect consumers' welfare. That index therefore reflects only the prices of consumption goods; it excludes the prices of investment goods, intermediate goods, and goods bought by governments. In order to reflect the changes in welfare, the measure should take into account the way households alter the mix of goods they consume when their preferences change or when they respond to changes in relative prices. Measures of inflation, however, usually measure the change in the price of a fixed basket of goods and services; they do not reflect changes in the mix of expenditures. Finally, a cost-of-living index must include transitory or one-time changes in prices because such changes affect consumers' welfare.

The BLS could, however, develop separate indexes for inflation and changes in the cost of living. The inflation measure would be a fixed-weighted index that would cover more than just consumption items. At a minimum, the index should include the prices that governments pay for goods and services and, perhaps, the prices of some intermediate goods such as

capital equipment. Well-defined transitory price changes or one-time changes to the price level, such as changes in excise taxes, would be eliminated from this measure. The BLS could create an approximation of such a measure with existing data in the national income and product accounts, although the reliance of the NIPAs on the CPI for deflators for consumption goods and services would still be a problem. Also, it may be necessary to examine whether the NIPA deflators for other categories of final demand are properly adjusted for changes in quality.

The separate cost-of-living measure could be a modified version of the current CPI, although the apparently unresolvable questions regarding the treatment of medical care in a cost-of-living index would remain. The cost-of-living measure could try to capture some of the commodity substitution effect by using a moving market basket--perhaps a moving three-year average of weights as determined in the consumer expenditure survey--instead of relying on major revisions every 10 years. More extensive adjustments for changes in quality could be tested and embodied in the index if the results were reliable and generally acceptable.

Having two indexes may, however, cause confusion and reduce the credibility of both. That would be a severe shortcoming, since the credibility of the current process for determining the CPI is a valuable asset.

