U.S. Inflation Developments in 1996

By Todd E. Clark

The primary goal of Federal Reserve monetary policy is to foster maximum long-term growth in the U.S. economy by achieving price stability over time. Price stability will be achieved, according to some definitions, when inflation ceases to be a factor in the decision-making processes of businesses and individuals. Although the Federal Reserve has made considerable progress toward price stability since the early 1980s, inflation remains above the level most analysts would associate with price stability. Because stable prices are essential to maximum long-term economic growth and living standards, the Federal Reserve seeks to contain and gradually reduce inflation until price stability is attained.

This article reviews inflation developments in the United States during 1996 in relation to the Federal Reserve's goal of achieving price stability over time. The first section examines the behavior of inflation over the past year, showing that sharp increases in food and energy prices caused most overall inflation measures to rise, while inflation in nonfood and nonenergy prices slowed. The second section shows that expectations of future inflation held steady at about the current rate, indicating the public expects no further progress toward price stability. The third section evaluates some inflation measurement issues raised in 1996, concluding that problems in accurately measuring inflation will require the Federal Reserve to monitor all price trends with vigilance. Together, the inflation developments of the past year were mixed.

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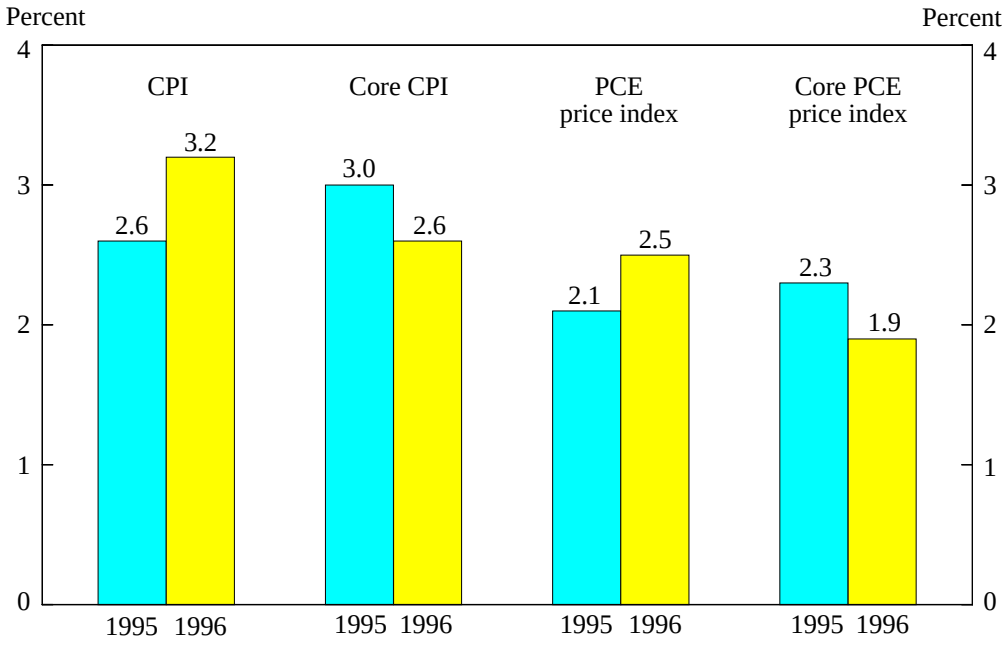
I. INFLATION IN 1996

As measured by all of the major indexes described in the box, prices continued to rise moderately in 1996. Inflation in the CPI for all items was 3.2 percent, up from 2.6 percent in 1995 (Chart 1).[1] Inflation in the so-called core CPI, which excludes food and energy prices, declined from 3.0 percent in 1995 to 2.6 percent in 1996. According to an alternative measure of consumer prices, the chain-weighted price index for personal consumption expenditures (PCE price index), inflation was somewhat lower but similarly behaved.[2] Inflation in the overall PCE price index rose from 2.1 percent in 1995 to 2.5 percent in 1996, while inflation in the core PCE price index slowed from 2.3 to 1.9 percent.

Other measures of inflation in final goods and services prices also remained moderate (Chart 2). Inflation in the chain-weighted price index for gross domestic product (GDP price index) was 2.1 percent, down from 2.5 percent in 1995. Inflation in the producer price index for finished goods (PPI) rose from 2.2 percent in 1995 to 2.9 percent in 1996. Inflation in the core PPI for

Chart 1
CONSUMER PRICE INFLATION



Note: Data are Q4/Q4 percent changes.

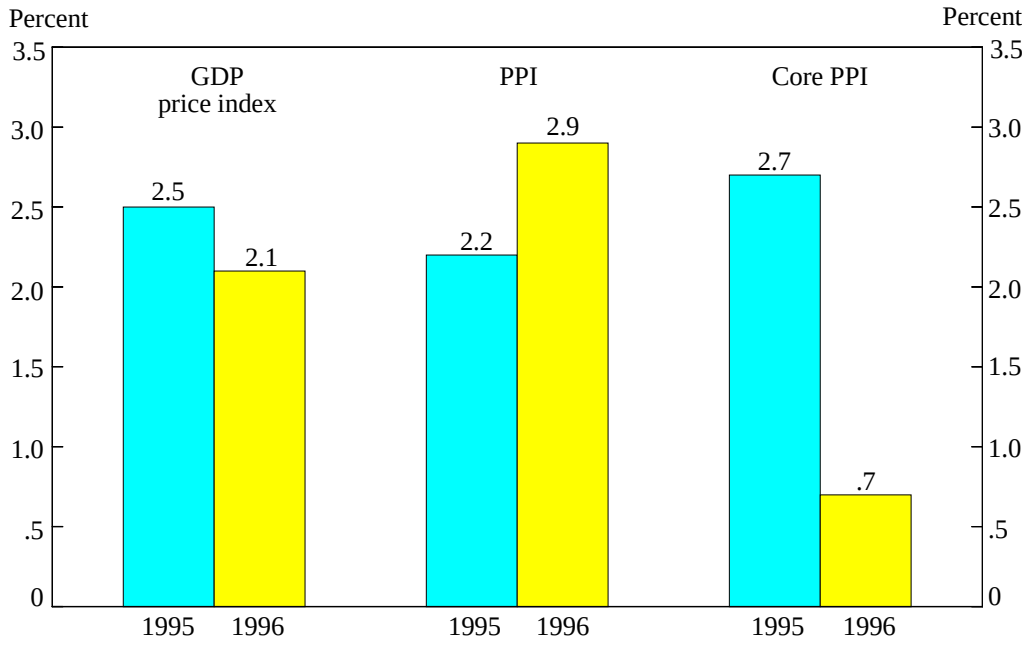
finished goods, which excludes food and energy prices, slowed from 2.7 percent in 1995 to 0.7 percent in 1996.

The effects of food and energy prices on inflation

The behavior of inflation in 1996 was importantly affected by food and energy prices. Large increases in food and energy prices pushed up most measures of overall inflation, including the CPI, PCE price index, and PPI. The sizable increases in food prices were the result of poor crop conditions. With grain stocks already low by historical standards, poor crops drove up grain prices and, in turn, prices for foods such as dairy products and meats. The large increases in energy prices reflected supply problems and strong demand. Specifically, the combination of weather-related supply disruptions and strong worldwide demand caused the prices of heating oil and gasoline to surge.[3] Robust demand also produced sharp gains in natural gas prices.

Despite their large impact on overall inflation, food and energy prices had little effect on core inflation in 1996. By definition, the core CPI, PCE, and PPI exclude food and energy prices. Therefore, big changes in food or energy prices affect core inflation only if the changes pass through to other prices, and then only with a lag. The increases in food and energy prices in 1996 did not pass through to core inflation.[4]

Chart 2
OTHER MEASURES OF INFLATION



Note: Data are Q4/Q4 percent changes.

The effects of other factors

While food and energy prices affected only overall inflation, several other factors affected both overall and core inflation in the past year. One factor was the level of resource utilization, which generated modest inflationary pressures. The economy continued to operate at a high level of resource utilization in 1996 (Chart 3). Throughout the year, the rate of capacity utilization in manufacturing stayed at about 82 percent, the rate at which inflationary pressures have historically begun to emerge (Garner). The unemployment rate averaged 5.4 percent, a rate somewhat below the "natural rate"—the lowest rate associated with stable inflation (Weiner). Most estimates place the natural rate between 5.5 and 6.0 percent. The labor market tightness evident in the low unemployment rate appeared to put some upward pressure on wages and salaries over the year. Average hourly earnings and the wage and salary component of the employment cost index grew more rapidly in 1996 than in 1995 (Table 1).[5]

However, any inflationary pressures generated by the strong economy may have been mitigated by workers' continued job insecurity and high profit margins in the business sector. Surveys suggest that workers remain concerned about job security. That concern may have limited wage demands in 1996, moderating the wage pressures normally associated with tight labor markets (Board of Governors of the Fed-

Chart 3
UNEMPLOYMENT AND CAPACITY UTILIZATION

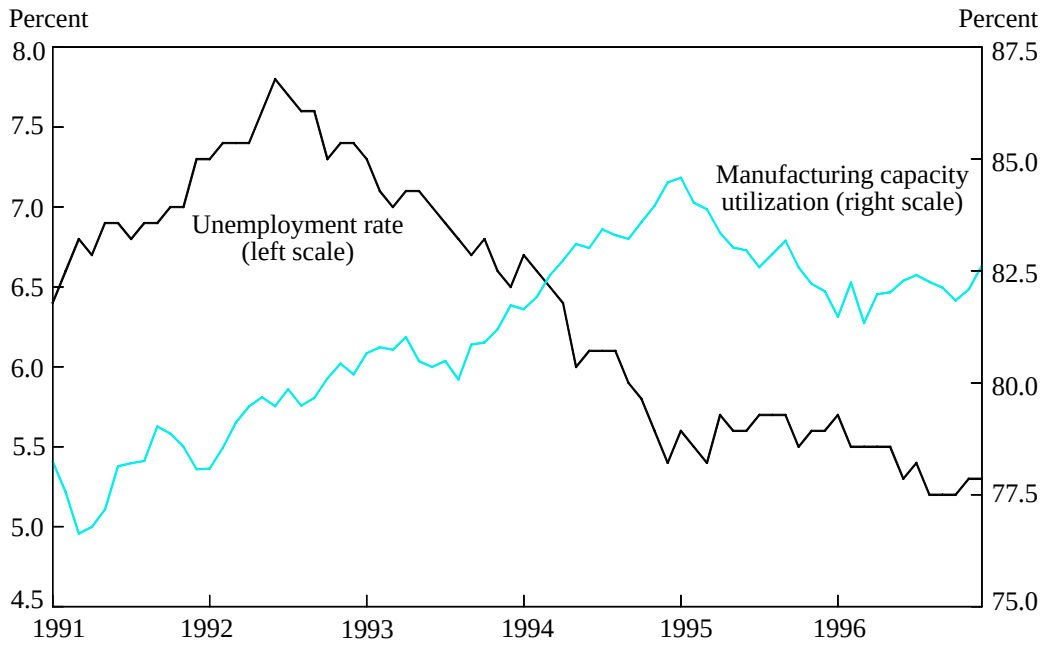


Chart 3x

eral Reserve System, p. 4). Moreover, corporate profit margins were large in 1996 (Chart 4).[6] Such strong profits allowed firms to absorb the relatively moderate acceleration of wages generated by tight labor markets without raising prices more than in recent years. Firms were able to cover the increase in wage costs by reducing their profit margins rather than by boosting prices.

Other factors worked to offset any inflationary pressures. First, the strengthening of the dollar in 1996 led to lower prices for many imported goods. Some analysts have attributed the slowing of core consumer price inflation in 1996 to declining import prices. Second, some technical adjustments to the procedures used in constructing the CPI and core CPI slightly reduced measured inflation in those indexes (U.S. Department of Labor 1996c). The adjustments, made in mid-1996 to resolve some previously identified problems in the indexes, probably slowed overall and core CPI inflation in 1996 by slightly less than 0.1 percentage point.[7]

Some analysts have argued that any inflationary pressures in 1996 were also offset by slower medical price inflation and more rapid declines in personal computer prices. Firms' continued efforts to shift employees to managed health care plans helped to reduce inflation in prices of medical services last year. Adjusted for quality improvements in personal computers, prices of computers declined more rapidly in 1996 than

Table 1

GROWTH IN WAGES AND SALARIES

	Average hourly earnings	Employment cost index for wages and salaries
1995	3.1	2.9
1996	3.4	3.3
Q1	2.3	3.9
Q2	3.9	3.6
Q3	3.4	2.6
Q4	4.0	3.2

Notes: Annual growth rates are Q4/Q4 percent changes. Quarterly growth rates are annualized percent changes between the preceding quarter and the current quarter.

in previous years, partly because memory prices plummeted. In an accounting sense, the deceleration of medical and computer prices modestly slowed inflation in 1996. For example, about one-fifth of the decline in core CPI inflation may be attributed to slower medical price inflation.[8]

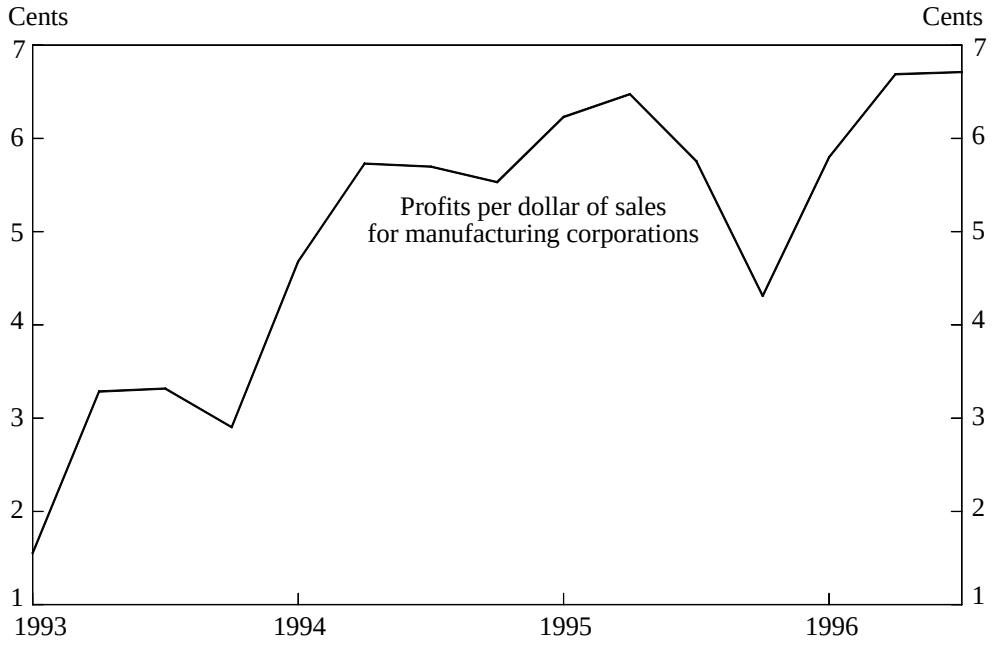
Many economists would argue, however, that medical and computer prices should not be highlighted as special factors affecting inflation. In any given year, the prices of some goods rise more rapidly than the prices of other goods, as relative prices move in response to changing supply and demand conditions for each good. Such relative price movements are unrelated to inflation trends and should not be viewed as special factors affecting inflation. In this view, the substantial slowing of medical and computer price inflation in 1996 represented changes in the relative prices of medical care and computers that were unrelated to inflation trends.

Overall, the behavior of inflation last year represented modest, although mixed, progress toward price stability. While large increases in food and energy prices caused most measures of overall inflation to rise in 1996, indicators of core inflation, such as the core CPI, declined. The next section evaluates whether the public expects progress toward price stability in 1997 and future years.

II. INFLATION EXPECTATIONS IN 1996

Examining expectations of future inflation provides another useful means of gauging progress toward price stability. Expectations provide a signal of the public's perception of a central bank's commitment to price stability. If the public believes a central bank will act to achieve a goal of gradually reducing inflation, expectations of inflation some years into the future will probably be less than the current rate of inflation. In contrast, if the public doubts the central bank will act to achieve the goal of reducing inflation, expectations of future inflation are likely to remain near the current rate. In 1996, both short-term and long-term inflation expectations held

Chart 4
CORPORATE PROFIT MARGINS

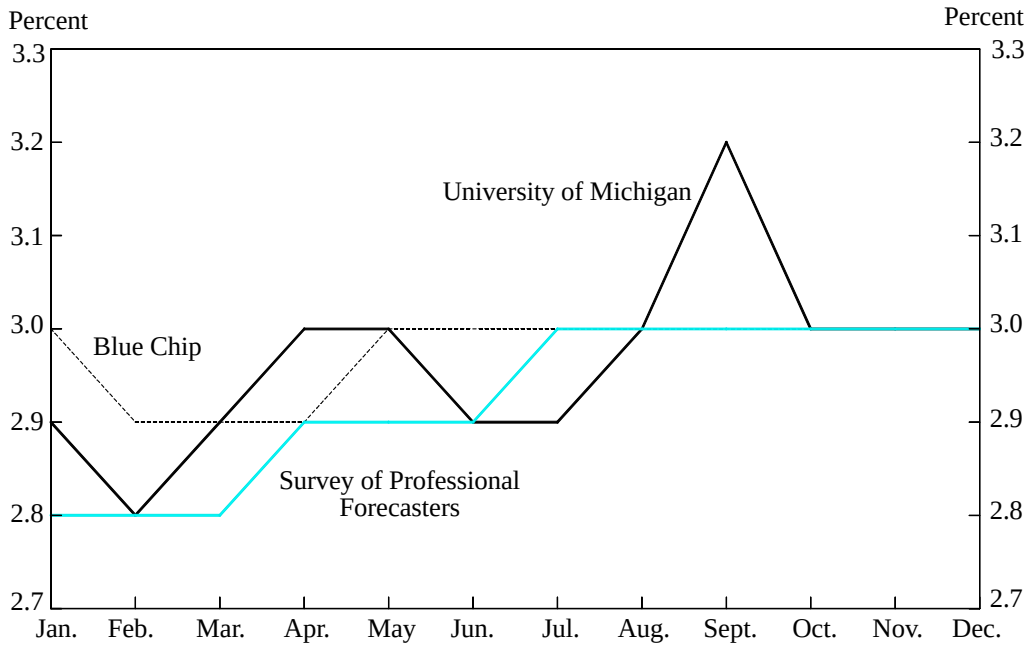


steady, with inflation generally expected to remain near its current level. Therefore, the public does not appear to anticipate any further progress toward price stability.

Short-term expectations

Measures of short-term inflation expectations were little changed in 1996, with inflation expected to remain near the actual 1996 level (Chart 5). One measure of inflation expectations is the Blue Chip consensus forecast for CPI inflation in 1997 (Q4/Q4). According to this indicator, expectations changed little over 1996. Forecasters expected 1997 inflation of 3.0 percent in January, 2.9 percent in February through April, and 3.0 percent over the rest of 1996. A second measure of expectations is provided by the average CPI inflation forecast from the Survey of Professional Forecasters, compiled quarterly by the Federal Reserve Bank of Philadelphia.[9] By this measure, inflation expectations for 1997 rose from 2.8 percent in the first quarter to 2.9 percent in the second quarter and 3.0 percent in the last half of the year. The University of Michigan's survey of consumers provides another indicator of inflation expectations. According to this survey, consumer expectations of inflation were more volatile than professional forecasts, but they too were little changed over the year as a whole. For most of the year, consumers' expectations of inflation for 12 months ahead hovered around 3.0 percent.[10]

Chart 5
SHORT-TERM INFLATION EXPECTATIONS, 1996



Notes: The Blue Chip consensus data are forecasts of CPI inflation from 1996:Q4 to 1997:Q4. The Survey of Professional Forecasters data are forecasts of average annual inflation for 1997. The University of Michigan data are expected CPI inflation over the next 12 months.

Long-term expectations

Long-term inflation expectations also held steady in 1996 (Table 2). The Survey of Professional Forecasters provides one indicator of long-term inflation expectations—CPI inflation expected over the next ten years. By this measure, expectations were unchanged in 1996, with the ten-year forecast staying at 3.0 percent from the fourth quarter of 1995 through the fourth quarter of 1996. The Livingston Survey, also compiled by the Federal Reserve Bank of Philadelphia, provides another forecast of CPI inflation over the next ten years. In June and December of each year, the Livingston Survey presents an average of the forecasts of economists from business, government, banking, and academia. According to the Livingston Survey, expectations edged up from 3.0 percent in December 1995 to 3.1 percent in June 1996 and returned to 3.0 percent in December 1996.

III. INFLATION MEASUREMENT

Although the public expects CPI inflation to remain near recent levels, changes to the procedures used in computing the index will modestly slow measured CPI inflation in 1997 and future

Table 2

LONG-TERM INFLATION EXPECTATIONS

Survey date	Survey of Professional Forecasters
1995:Q4	3.0
1996:Q1	3.0
Q2	3.0
Q3	3.0
Q4	3.0
Survey date	**Livingston Survey**
December 1995	3.0
June 1996	3.1
December 1996	3.0

years. The procedural changes either have already or will soon be made in an effort to resolve some measurement problems that cause the CPI to overstate consumer price inflation. The problems with the CPI were summarized last year in the so-called Boskin Report, the final report to the U.S. Congress of the Advisory Commission to Study the Consumer Price Index. In light of these problems, would one of the other available price indexes provide a better measure of inflation? How much will changes in methodology affect measured CPI inflation? What are the implications for monetary policy and the pursuit of price stability?

Is the traditional focus on the CPI misplaced?

Four overall indexes of final goods and services prices are available. The CPI and the PCE price index measure the average change in the prices of consumer goods and services. The GDP price index tracks the prices of all final goods and services, including goods and services purchased by consumers, businesses, and government. The PPI measures prices received by producers of finished goods. The box describes the indexes in more detail.

Attention has traditionally focused on the CPI for four reasons. First, the index is generally recognized as one of the highest quality statistical series produced by the U.S. government (Griliches; Shapiro and Wilcox). Second, the CPI has a solid grounding in economic theory, providing an approximation to the cost of living for the typical U.S. consumer. Third, the index is available on a timely basis. The CPI is reported monthly, about two weeks after the end of the reference month. Finally, the CPI is used in making cost of living adjustments to federal retirement benefits such as social security and to many wage and commercial contracts in the private sector—in part because the CPI provides a quality and timely approximation to changes in the cost of living.

Problems with the CPI. Although the CPI has several merits, the index is not perfect, as highlighted by the Boskin Commission. Some general measurement problems, detailed in the appendix, cause the index to overstate inflation. Although estimates vary widely, many analysts place the overall bias in CPI inflation at about one percentage point per year (Advisory Commission to Study the Consumer Price Index; Shapiro and Wilcox).[11]

The single largest source of mismeasurement in the CPI is probably the so-called *quality bias*. The prices and qualities of many goods and services change over time. Typically, some of an observed price increase reflects quality improvement, while some of a price increase represents true inflation. Correctly measuring inflation therefore requires adjusting for quality changes, such that measured inflation is the average change in prices of constant-quality goods and services. Many believe the CPI generally understates quality improvements and, as a result, overstates true price inflation.

A specific source of quality bias in the CPI is the index's treatment of medical services (Advisory Commission to Study the Consumer Price Index; Shapiro and Wilcox). The quality of medical care has improved because treatments once provided on an inpatient basis, such as cataract surgery, can now be completed on an outpatient basis. In principle, measuring the quality-adjusted cost of cataract removal seems simple, requiring only data on the fees charged for the surgery, whether inpatient or outpatient. In practice, however, the measurement is problematic (Shapiro and Wilcox). For a variety of practical reasons, the cost of cataract surgery has traditionally been evaluated using the prices of inputs to the surgery, such as a hospital stay, rather than the simple price of the surgery. In recent years, the set of inputs to cataract removal has changed as the surgery has moved from an inpatient to outpatient basis. The CPI, however, has continued to price more traditional inputs, such as a hospital stay, and missed the cost savings associated with changes in the surgery. The CPI has therefore overstated inflation in medical costs.

Advantages of the alternatives. The problems with the CPI naturally lead to questions about whether the PCE price index, GDP price index, or PPI might provide a better measure of inflation. Comparing these alternative indexes with the CPI reveals some advantages of the alternatives. Specifically, the PCE price index is a better measure of inflation than the CPI in two respects. First, at times, some of the specific item prices in the PCE price index are more accurate than the prices in the CPI. In 1996, for instance, the PCE price index used measures of the costs of hospital services that were probably more accurate than the measures used in the CPI.

Second, the PCE price index is less affected by one of the measurement problems in the CPI, known as *substitution bias*. Both indexes are weighted averages of the prices for specific goods and services, with weights determined by the composition of household purchases. When prices change by differing amounts, consumers may substitute some goods for others, shifting the composition of purchases. Substitution may occur across general categories of goods, such as from frozen meals to canned soup. Substitution may also occur across specific goods within a category, such as from one type of frozen meal to another. The PCE price index allows for substitution across categories of goods, but not across specific goods within a category.[12] In contrast, the CPI assumes neither type of substitution occurs.[13]

The GDP price index and PPI also offer some advantages relative to the CPI. Like the PCE index, the GDP price index uses some specific

item prices that may be more accurate than the prices used in the CPI and is less affected by substitution bias. In addition, the GDP price index provides a broader measure of inflation, covering all final goods and services. The PPI offers the advantage that the index may use more accurate measures of prices for some items covered in both the CPI and PPI.[14] For example, some analysts believe medical costs and computer prices are measured more accurately in the PPI than in the CPI.

Problems and disadvantages of the alternatives. Although the PCE and GDP price indexes and PPI offer some advantages, they are affected by many of the measurement problems that plague the consumer price index. Like the CPI, the PCE and GDP price indexes and PPI all likely overstate inflation. Many studies have documented measurement biases in the PPI.[15] And, although very few studies have examined the quality of the PCE and GDP price indexes, the construction of the indexes subjects them to measurement biases. Most of the specific item prices used in constructing the PCE and GDP price indexes come from the CPI and PPI. For example, roughly three-fourths of the price information used in constructing the GDP price index is from the CPI and PPI (Wynne and Sigalla). Thus, the basic measurement problems of the CPI and PPI plague the PCE and GDP price indexes.[16]

The PCE and GDP price indexes and PPI also have some disadvantages when compared with the CPI. The PCE and GDP price indexes have two disadvantages in common. First, the overall quality of the indexes is uncertain but is generally expected to fall short of the quality of the CPI. Some of the specific item prices used in the PCE and GDP price indexes are derived from sources other than the CPI and PPI. Although some of the specific item prices may be accurate, in general the quality of the data is unknown or suspect. The GDP price index, for example, uses price data for the construction sector that have historically overstated the rate of inflation in construction prices (Pieper 1989, 1990).[17] Second, the PCE and GDP price indexes provide less timely measures of inflation. The indexes are reported on a quarterly basis, about one month after the end of the reference quarter.[18] The PCE price index carries one additional disadvantage. As a measure of consumer prices, the index has some conceptual flaws.[19] For example, the PCE price index reflects spending by both consumers and nonprofit institutions.

The PPI has two disadvantages relative to the CPI. First, the producer price index largely excludes the prices of services, thereby failing to represent price trends in an important sector of the economy.[20] Second, the PPI lacks a strong theoretical basis. An ideal producer price index would measure the average change in the prices of either inputs to or outputs of a well-defined sector of the economy. The PPI, however, includes both input and output prices, and does not correspond to a well-defined sector (Gaddie and Zoller). For example, the PPI covers the prices of some finished consumer goods and some goods used as inputs in the production of other goods.

Overall, the relative merits of the available inflation measures warrant a continued focus on the CPI, as well as some attention to the other price indexes. Although the CPI is far from perfect, the index provides a high-quality and timely approximation to changes in the cost of living. The PCE price index, GDP price index, and PPI are also imperfect measures of inflation and have some disadvantages when compared with the CPI. But the indexes offer some advantages and therefore also bear monitoring. In recent years, for example, the PCE price index has measured medical costs more accurately than the CPI.

The effects of changes in CPI methodology

Some of the problems with the CPI have recently been or will soon be remedied by changes in the procedures used to calculate the index. Over the course of 1995 and 1996, the Bureau of Labor Statistics, the government agency responsible for the CPI, implemented several methodological changes. As announced last year, further changes will be made in 1997 and 1998. These procedural modifications address some of the problems that cause the index to overstate true consumer price inflation and are therefore generally expected to slow measured CPI inflation by a modest amount.

In a series of steps taken in 1995 and 1996, the BLS fixed a basic problem in the way prices for newly priced items were entered into the CPI. New items enter the CPI because the BLS rotates the sample of specific items included in the CPI from year to year in an effort to keep up with shifts in consumer spending habits. For example, the BLS may rotate from measuring the price of bananas at one supermarket to measuring the price at another supermarket in the same area. New items also enter the CPI because the BLS replaces specific items previously included in the index that become unavailable with substitutes.

The procedural changes were first applied in the food category of the index in January 1995 and then to the rest of the index in June and July of 1996. The modifications will eliminate one source of bias in the CPI, known as the *formula bias*. Overall CPI inflation is expected to slow a total of 0.21 percentage point per year, with 0.11 percentage point attributable to the 1995 changes and 0.10 percentage point attributable to the 1996 changes (Armknecht, Moulton, and Stewart; Henderson and Smedley; and U.S. Department of Labor 1996c).[21] But because the modifications were only completed in mid-1996, their full impact will not be felt until 1997. Dividing the effect of 1996's procedural changes in half to reflect their midyear timing, the changes probably reduced overall inflation by about 0.05 percentage point in 1996 and will reduce inflation by another 0.05 percentage point in 1997.

As announced in June 1996, in January of this year the BLS made changes to one of the medical cost components of the CPI, the hospital and related services component. Specifically, the BLS reclassified items within the hospital and related services category into a smaller set of main groups and redefined the items for which prices are collected (U.S. Department of Labor 1996b).[22] The changes are designed to better capture in the CPI the effects of advancing medical technology on the cost of living, particularly the cost savings associated with a treatment shifting from an inpatient to outpatient basis. While many analysts expect these modifications to slow measured CPI inflation, no estimates of the effects are available. Because the items being priced have changed fundamentally, the BLS has been unable to project the effects of the changes from past data. With hospital and related services receiving a weight of roughly 2 percent in the CPI, the effects will probably be very small.

Finally, in January 1998 the BLS will update the basket of goods and services for which the CPI tracks prices. Currently, the basket is based on the expenditures of the typical consumer over 1982-84. Next year, the basket will be based on the 1993-95 expenditures of consumers. Traditionally, the CPI basket has been updated about once every ten years, and the upcoming revision keeps with tradition. In the near term, the changing of the market basket will probably help to mitigate the substitution bias in the CPI. Although the CPI assumes consumers have made no substitutions in response to different changes in prices, spending patterns have probably shifted considerably

ALTERNATIVE INFLATION MEASURES

A number of measures of inflation in final goods and services are available. These include the consumer price index *(CPI)*, chain-weighted price index for personal consumption expenditures *(PCE price index)*, chain-weighted price index for GDP *(GDP price index)*, and producer price index for finished goods *(PPI)*. The CPI and PCE price index measure the prices of consumer goods and services. The GDP price index tracks the prices of all final goods and services, including goods and services purchased by consumers, businesses, and government. The PPI tracks prices received by producers of finished goods.

More specifically, the consumer price index tracks the average change in the prices of a fixed set of goods and services purchased by the typical consumer. The all-items CPI, known simply as *the CPI*, measures the average price change of goods and services. The consumer price index is known as a *fixed-weight* index because the basket of goods and services is fixed from year to year. More specialized indexes of consumer prices are also available. The *core* CPI measures the prices of nonfood and nonenergy goods and services. The exclusion of food and energy prices, which tend to be highly volatile, can sometimes help make underlying inflation trends more apparent.

The chain price index for personal consumption expenditures provides an alternative measure of consumer prices. Like the CPI, the PCE price index measures the average change in the prices of goods and services purchased by consumers. Moreover, most of the prices for specific goods and services included in the PCE price index come from the CPI. However, the PCE price index differs from the CPI in some important ways. First, the PCE price index allows for broad year-to-year changes in the basket of goods and services purchased by consumers. Particularly, the index allows for shifts across general categories of goods, such as from ground beef to frozen food. Inflation in the PCE price index is the average of two different fixed-weighted measures of overall price change. In measuring inflation from the past year to the current year, one fixed-weighted index uses the past year's composition of consumption purchases to weight individual price changes, while the other index uses the current year's composition of purchases to weight individual price changes. Second, for some items, the PCE price index and the CPI use different price information. For example, the PCE price index is constructed using producer, rather than consumer, price indexes for computers. Third, the weights assigned to specific items differ between the PCE price index and the CPI. Medical care, for instance, receives a larger weight in the PCE price index than in the CPI.[23]

The GDP price index measures the average price change for all final goods and services produced in the United States. Unlike the CPI and PCE price index, the GDP price index excludes the prices of imports. Like inflation in the PCE price index, inflation in the GDP price index is the average of two different fixed-weighted measures of overall price change. One of the fixed-weighted indexes uses the past year's composition of purchases to weight individual price changes, while the other index uses the current year's composition of purchases to weight individual price changes. Roughly three-fourths of the specific item prices used to construct the GDP price index come from the CPI and PPI.

Finally, the producer price index for finished goods tracks the average change in prices received by domestic producers of a fixed set of goods. While the PPI includes some services, the index largely reflects just goods prices. A core PPI for finished goods—which excludes food and energy prices—is also available.

since 1982-84. The BLS estimates the update may slow measured consumer price inflation by 0.1 or 0.2 percentage point per year beginning in 1998 (U.S. Department of Labor 1996a).

Implications for monetary policy

The flaws of the available price indexes and recent and future changes in CPI procedures imply that making progress toward price stability will require vigilance on the part of the Federal Reserve. Because each of the available price indexes are imperfect, the Federal Reserve must continue to monitor all of the indexes in gauging progress toward price stability. Although the CPI generally appears to provide the single best inflation measure, the PCE and GDP price indexes and the PPI can also provide useful information. For example, comparing the CPI and the PCE price index suggests that the CPI has been overstating consumer price trends in recent years—and that the economy is somewhat closer to price stability than the CPI indicates.[24] Medical costs, measured less accurately in the CPI than in the PCE price index, have been rising at a more rapid rate in the CPI. The gap in measured medical price inflation has helped cause inflation in the CPI to outpace inflation in the PCE price index. Therefore, the problems with the CPI's measurement of medical costs appear to cause the index to overstate inflation.

Recent and future changes in BLS procedures imply that the Federal Reserve must achieve small reductions in CPI inflation in 1997 and 1998 for no ground to be lost in the pursuit of price stability. By themselves, the procedural adjustments are expected to slow CPI inflation in 1997 and again in 1998. CPI inflation calculated under the new procedures will be lower than what inflation calculated under old procedures would be. Therefore, simply holding the line in the battle toward price stability will require a modest slowing of CPI inflation in 1997 and 1998. Progress toward price stability will necessitate more sizable reductions in CPI inflation.

IV. CONCLUSIONS

Given the goal of containing and ultimately reducing inflation, the developments of the past year were mixed. Most measures of overall inflation rose, while core inflation fell. Expectations of future inflation remained near the current level of inflation, suggesting the public anticipates no further progress toward price stability. Problems in measuring inflation and changes in CPI procedures mean that making progress toward price stability will require vigilance from the Federal Reserve. Because the major price indexes all provide imperfect measures of inflation, gauging progress toward price stability will necessitate monitoring all of the indexes.

APPENDIX

THE BIAS IN CPI INFLATION

As highlighted in a recent report to the U.S. Congress, the CPI may overstate true consumer price inflation (Advisory Commission to Study the Consumer Price Index). Analysts generally agree the Bureau of Labor Statistics does a good job in computing the index but that some problems are inevitable (Shapiro and Wilcox). In particular, the CPI suffers *substitution, quality,* and *outlet substitution* biases.[25] Until mid-1996, the CPI also suffered a *formula* bias. All of these biases may cause the CPI to exaggerate true inflation. However, estimates of the size of the overall bias vary widely.

Substitution bias. Consumer price inflation is generally intended to refer to increases in the overall cost of living. Accordingly, an increase in the price of just one item purchased by a consumer may not generate much inflation. Consumers can typically substitute another good for the good whose price has risen. Such substitution will mitigate the increase in expenditure needed for consumers to maintain a desired standard of living. Therefore, substitution will mitigate the inflationary effects of an increase in a particular good's price.

The CPI overstates inflation because the index does not allow for substitution among goods. The index measures the average price change in a *fixed* set of goods. The CPI may then exaggerate inflation because the index tracks the cost of the same set of goods, when in fact the set of goods may change if consumers substitute among goods as individual prices change by different amounts. Recognizing this bias, the BLS stresses that the CPI is not a true cost of living measure and may exaggerate increases in the true cost of living (U.S. Department of Labor 1992).

Substitution bias may affect the CPI at two levels (Moulton). Substitution can occur across general categories of goods or across specific goods within a category. For example, consumers may choose to substitute frozen meals for canned soup if soup becomes relatively more expensive. Consumers might also choose to substitute one type of frozen meal for another. Substitution across general categories of goods is known as *high-level substitution*. Substitution within categories of goods is referred to as *low-level substitution*.[26] Many discussions of the *substitution bias* focus exclusively on high-level substitution. However, recent BLS research suggests that low-level substitution may also be important (Bradley and Reinsdorf).

Quality bias. The prices and qualities of many goods and services change over time. The price and quality of the typical car, for example, have increased significantly. Some of an observed price increase will reflect

APPENDIX - continued

quality improvement, while some of it will represent true inflation. A variety of methods are used to measure quality and in turn separate the change in an item's price due to quality from the change that truly represents inflation. The CPI is intended to track changes in prices measured to be truly inflationary, rather than due to quality.

Mismeasurement of the quality of goods may lead to a bias in the CPI. Most analysts believe the methods for measuring quality understate improvements in quality.[27] Such understatement means that too little of an observed price change is attributed to quality and too much is treated as a truly inflationary price change. As individual price changes are overstated because some component of a measured price change actually reflects quality improvement, the consumer price index overstates inflation.

Outlet substitution bias. Over time, consumers change the retail outlets from which they make purchases, substituting one store for another. Particularly, in recent years consumers have shifted from making purchases at smaller, more specialized stores toward making purchases at larger discount stores. Typically, a discount store sells an item for considerably less than a smaller specialty store.

The outlet substitution bias arises because current CPI procedures essentially ignore the decline in price that occurs as consumers shift from a traditional store to a discount store. In many cases, discount store prices are lower because the store provides less service than a smaller specialty store. In this sense, the item purchased at the discount outlet has lower quality. Based on this view, the BLS attributes the reduction in price that occurs with outlet substitution entirely to a decline in quality and records no true price change. In fact, some of the discount outlet's price advantage may not be entirely due to lower quality and may therefore represent a truly lower price. For example, discount stores might have lower costs because they have more efficient inventory systems and are able to buy larger quantities of goods at lower wholesale prices. To the extent not all of the gap in price between a discount store and a more specialized store is due to a difference in service provided, the CPI will fail to pick up a true price reduction when outlet substitution occurs. As a result, the CPI may overstate inflation.

Formula bias. Because it is practically impossible to collect prices on all consumer items sold in the United States, the CPI is based on a large, representative sample of prices (U.S. Department of Labor 1992). Specifically, the CPI is a weighted average of sampled price changes, with weights that reflect the importance of each item in overall consumer expenditures. Over time, the sample of specific items included in the CPI changes. The BLS regularly rotates the sample of items and retail outlets from which prices are taken in an effort to keep up with changes in consumer purchasing patterns. For example, in any given year the BLS may

APPENDIX - continued

rotate from measuring the price of bananas at one supermarket to measuring the price at another supermarket in the same area. Moreover, previously priced items sometimes become unavailable, requiring the selection of a substitute item. Such changes in the sample of items require the BLS to link new item prices into the CPI.

Until July 1996, BLS procedures for linking new item prices into the CPI caused the index to overstate inflation.[28] The formulas used to link prices of new items into the CPI gave too much weight to prices that were temporarily low and too little weight to prices that were temporarily high. As low prices tend to rise relatively rapidly and high prices rise slowly, CPI procedures gave excessive weight to rapidly rising prices and insufficient weight to slowly rising prices. Consequently, the CPI overstated inflation somewhat. In a series of steps taken in January 1995, June 1996, and July 1996, the BLS implemented procedural changes that eliminate the formula bias (Armknecht, Moulton, and Stewart; Stewart 1996a, 1996b).[29]

Size of the bias. The magnitude of the overall bias in CPI inflation is highly uncertain. Most researchers agree on only two points. First, the bias in CPI inflation attributable to high-level substitution amounts to about 0.2 percentage point per year. Second, the quality bias is probably the single largest source of overstatement. Apart from these points, there is considerable uncertainty and disagreement about the sizes of the current biases in the CPI. Some analysts argue the CPI may overstate inflation by a total of almost two percentage points per year, while others believe the overall bias is less than one percentage point (Moulton). Most place the total bias at about one percentage point per year, with a possible range of about 0.5 to 1.5.

ENDNOTES

[1] On a December-to-December basis, CPI inflation was 3.3 percent in 1996, up from 2.5 percent in 1995. Core CPI inflation was 2.6 percent in 1996, down from 3.0 percent in the previous year.

[2] The box describes some differences in the construction of the CPI and the PCE price index. In general, the 1996 gap between the CPI and PCE inflation rates reflects those differences. More specifically, differences in the indexes' treatment of housing, personal computers, and medical services account for much of the recent gap. Housing costs have risen slightly faster than the prices of other goods and services, and the weight on housing in the CPI is about twice the weight on housing in the PCE price index. The computer prices used in the PCE price index, which are taken from the PPI, have fallen more rapidly than the computer price indexes used in the CPI. Reflecting more recent spending patterns, the PCE price index also assigns a larger weight to computers. Similarly, medical costs as measured in the PCE price index have risen more slowly than medical costs as measured in the CPI, and the PCE price index gives medical costs a much larger weight than the CPI does.

[3] Particularly, adverse weather reduced the supplies of crude petroleum, from which heating oil and gasoline are refined. With the supply of crude petroleum disrupted, strong demand for heating oil and gasoline caused the price of crude petroleum and, in turn, heating oil and gasoline, to surge higher.

[4] Typically, large movements in food or energy prices do not pass through to core inflation because the movements are soon reversed. However, in the unusual event that changes in food or energy prices persist for some time, the changes can temporarily affect core inflation. If energy prices double and remain fixed at the higher level, core inflation may be elevated for several years as firms producing nonenergy goods gradually pass through the energy cost increase. The increase in core inflation will be temporary because a permanent increase in the *level* of energy prices can have a permanent effect on only the *level* of core prices.

[5] The overall employment cost index accelerated less sharply than the wage and salary component of the index because the benefits component decelerated. With growth in the wage and salary component rising from 2.9 to 3.3 percent and growth in the benefits component slowing from 2.3 to 2.0 percent, growth in the overall index rose from 2.7 percent in 1995 to 2.9 percent in 1996.

[6] Some analysts have argued the robustness of profits is evidence that productivity is growing more rapidly than the measured data indicate (Cooper and Madigan).

[7] The procedural changes made in mid-1996 are expected to slow overall CPI inflation by 0.1 percentage point per year (U.S. Department of Labor 1996c). Since the adjustments were made in June and July, the changes should have affected overall inflation in 1996 by about half that amount, or 0.05 percentage point. Because the procedural changes of 1996 did not apply to the food at home component of the CPI, the changes should have a slightly larger impact on core inflation than on overall inflation.

[8] As measured in the CPI, the rate of change in medical prices and computer prices declined by about one percentage point in 1996. Medical care receives a weight of slightly more than 7 percent in the CPI, and computers receive a weight of less than 0.1 percent (as measured by December 1995 relative importance). The deceleration of medical and computer prices slowed core CPI inflation by a total of about 0.08 percentage point, with essentially all of the effect attributable to medical prices. The deceleration of medical and computer prices had a larger impact on inflation in the PCE price index than on CPI inflation because medical care and computers received larger weights in the PCE price index—about 16 percent and 0.4 percent, respectively (Advisory Commission to Study the Consumer Price Index, pp. 49, 57).

[9] The Livingston Survey of economists, another indicator compiled by the Federal Reserve Bank of Philadelphia, also showed steady inflation expectations. As of December 1995, the survey reported expected CPI inflation over the next 12 months of 2.9 percent. As of December 1996, the survey reported expected inflation for the next 12 months of 3.0 percent.

[10] Over much of 1996, expectations as measured by the Survey of Professional Forecasters and the Blue Chip consensus differed importantly from the University of Michigan's consumer survey in the forecast horizon. The professional surveys tracked expectations for 1997, while the Michigan survey tracked inflation expectations for 12 months into the future. Thus, early in 1996, the professional forecasts represented expectations for 1997 inflation, while the Michigan survey essentially represented expectations for 1996. By the end of 1996, the distinction was eliminated.

[11] The recent estimates of Advisory Commission to Study the Consumer Price Index (1996) and Shapiro and Wilcox (1996) reflect current knowledge of the problems in the CPI. Moulton (1996) surveys a larger set of estimates, not all of which reflect current knowledge, particularly on the formula bias.

[12] The PCE price index is constructed using detailed CPI price indexes on categories of goods and allows for substitution across those categories. However, the PCE price index implicitly assumes no substitution within categories, as the detailed CPI indexes are explicitly constructed assuming no substitution within categories.

[13] On an annual basis, the BLS has been reporting CPI measures that allow for substitution across general categories of goods. Like the PCE price index, the modified CPI measures are free of high-level substitution bias. But such measures cannot be reported on the same timely basis as the regular CPI.

[14] Wynne and Sigalla (1993) argue the PPI also offers the advantage that the index focuses on goods and largely excludes services, thereby providing a perhaps more accurate measure of inflation. Inflation in goods prices may be measured more accurately than inflation in services prices. However, because the BLS reports separate CPI indexes for goods and for services in addition to the overall CPI, the PPI would seem to have little advantage over the CPI in this regard.

[15] As summarized by Wynne and Sigalla (1993), many studies have identified substitution and quality biases in the PPI, as well as a bias attributable to the use of list rather than transactions prices.

[16] The PCE and GDP price indexes, however, are less affected by substitution bias. While the CPI suffers both high-level and low-level substitution biases, the PCE and GDP price indexes suffer only low-level bias.

[17] The problem with construction stems from the use of cost indexes to deflate nominal construction spending. The use of cost indexes is based on the assumption of constant productivity.

[18] The PCE and GDP price indexes are also less timely in that the indexes are subject to revision as more complete source data become available. By contrast, the CPI is essentially never revised.

[19] Although the problem with the PCE price index as a measure of consumer prices poses a disadvantage for the index, the GDP price index does not suffer the same disadvantage because the index is not generally used as a measure of consumer prices. The conceptual problem with the PCE price index relative to the CPI arises from the indexes having different measurement objectives (Fixler and Jaditz). While the CPI seeks to approximate the cost of living for the typical consumer, the PCE price index measures the average price change for goods and services purchased by persons, persons defined as individuals and nonprofit institutions.

[20] Although the PPI has historically focused almost exclusively on goods prices, the BLS began gradually expanding the coverage of services in 1986. The BLS plans to continue expanding services coverage and begin publishing an aggregate goods and services PPI by 2002.

[21] Moulton notes that some recent BLS research estimates a total effect of 0.24 percentage point.

[22] In recent years, the CPI failed to adequately reflect the sizable discounts many insurance companies receive from hospitals. Accordingly, beginning in January 1997 the BLS also intensified efforts to obtain data on the prices paid to hospitals rather than the prices charged by hospitals.

[23] In general, the CPI uses weights based on the Consumer Expenditure Survey, while the PCE price index uses weights based on spending by households as measured in the national income and product accounts. In the case of medical care, the CPI and PCE weights differ because the PCE index reflects both employer and employee expenditures while the CPI reflects only employee expenditures.

[24] However, both the CPI and the PCE price index indicate the past year brought modest, although mixed, progress toward price stability. Inflation in the core CPI and core PCE price index declined by similar amounts, and inflation in the overall indexes rose by similar amounts.

[25] The general quality bias encompasses a more specific problem, known as the *new goods bias*. The new goods bias stems from problems with pricing new goods, such as video cassette recorders, which have no well-defined antecedent and which have historically been introduced into the CPI well after they first were available to the typical consumer.

[26] Some analysts have argued for reducing or possibly eliminating the low-level substitution bias by using *geometric* rather than *arithmetic* means in aggregating specific item prices (Advisory Commission to Study the Consumer Price Index). In using arithmetic means, the BLS assumes no substitution across goods occurs—an elasticity of substitution of 0. The use of geometric means would mean assuming that a 1 percent change in a good's price leads to a 1 percent reduction in the good's quantity—an elasticity of substitution of 1. Whether the assumption underlying geometric means is more appropriate than the assumption underlying arithmetic means depends on consumer behavior. More research is needed to determine which assumption is more appropriate for the CPI.

[27] While most analysts agree the CPI understates quality and therefore tends to overstate inflation, some experts on price measurement disagree (Triplett 1975, 1988).

[28] The formula bias associated with routine sample rotation is sometimes specifically identified as the *sample rotation bias*.

[29] Items are now "seasoned" prior to introduction in the CPI. A new good is linked into the CPI using the price of the good from three months ago rather than the current month's price in determining the appropriate weight. Seasoning breaks the correlation between the weight and the price of the good at introduction into the CPI and therefore eliminates the formula bias.

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