

The Consumer Price Index: measuring inflation and causing it

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INFLATION is widely believed to be the most important economic problem facing the United States and most other countries in the world. Thus it is not surprising that the monthly publication of the U.S. Consumer Price Index (CPI) is so closely watched both inside and outside of government. Large increases in the CPI are bad news for Administration officials, particularly in election years, and may lead to sudden policy reversals such as the introduction of the Carter Administration's ill-fated credit controls in March 1980. Large increases in the CPI, however, are good news for millions of recipients of social security benefits, government retirement pay, and other payments that by law or contract must be escalated in step with the CPI. Also, since foreigners watch the CPI closely for clues to the future course of U. S. interest rates and the exchange value of the dollar, the CPI is probably the single most quoted economic statistic in the world.

Imagine that someone pushes the wrong button on a computer at the Bureau of Labor Statistics (BLS), the division of the Department of Labor that is responsible for the CPI, and records that the increase in the CPI over a particular year is 15 percent instead of the true rate of 10 percent. Government officials would probably react with restrictive policy measures—some combination of expenditure

reductions, tax increases, and higher interest rates. Thousands, perhaps millions, of Americans might be thrown out of work. Millions of others receiving social security benefits or union wages escalated by the CPI would enjoy a windfall gain, since their payments would go up by more than the true inflation rate. The unnecessary extra benefit payments would cause the government deficit to balloon, putting extra pressure on the Federal Reserve to print more money and finance still more inflation, while the higher union wage payments would put pressure on firms to raise prices faster than otherwise.

Exactly this chain of events occurred in the United States in 1979 and 1980, but not because of an easily correctable slip by BLS. Instead, a serious overstatement of inflation by the CPI was caused by built-in design flaws. These defects have come to light not through the snooping of some measurement-minded Woodward or Bernstein, but rather as a result of a growing discrepancy between the CPI and a competing government measure of consumer prices called the "Personal Consumption Expenditures deflator," published by a division of the Department of Commerce, and usually called the "PCE deflator" for short. Table I shows that after registering only a small difference in early 1978 and most earlier years, the inflation rate recorded by the two indexes grew apart by an amount that reached an annual rate of 5 percent in the first half of 1980.

The story of the two inflation indexes is a fascinating one, even for those whose eyes glaze over at talk of measurement procedures and who prefer to treat government economic data as unchallenged gospel. Since the CPI and PCE deflator are compiled from a common set of underlying price data by two different sets of rules, part of the tale involves the rules themselves, why they lead to different

TABLE I. *Inflation Rates as Estimated by the CPI and PCE Deflator (Percentage Changes at Annual Rates)**

	CPI	PCE DEFULATOR	DIFFERENCE
1. 1947-77	3.4%	3.3%	0.1
2. 1978-80 by half year			
1978, first half	8.9	8.3	0.6
1978, last half	9.0	6.8	2.2
1979, first half	12.6	10.0	2.6
1979, last half	13.0	9.8	3.2
1980, first half	16.2	11.2	5.0

* Source: CPI from Bureau of Labor Statistics; PCE Deflator from *Survey of Current Business*, various issues. These figures do not reflect the data revisions announced in December 1980 for the PCE deflator. A preliminary inspection suggests that the inflation rate of the PCE deflator in the new data is between 0.5 and 1.0 percentage points lower for each period shown since 1977. Because the CPI has not been revised, the difference between the two indexes has been further enlarged by the revisions.

results, and why the CPI rules are widely believed to be inferior to those used in the PCE deflator. Another aspect involves the internal workings of the BLS, where staff bureaucrats have long urged the replacement of obsolete rules for the measurement of housing prices but were forced by political pressure to retain the old rules in the new version of the CPI introduced in 1978. A final and less-reported chapter involves the adequacy of the underlying price data that both the CPI and PCE deflator share in common. These form the basis for all economic measures of real economic progress, or the lack of it, including those that show a drastic slowdown in the growth of U.S. productivity in the last decade. How effectively do official procedures handle innumerable situations when a new model or product costs more than the item it replaces, but differs in quality as well? New radial tires last longer than the old bias-ply type, and recent-vintage television sets both perform better and need fewer repairs than their predecessors. But if price indexes are not adjusted adequately for these quality improvements, inflation is overstated and the improvement in our productivity and standard of living is understated.

A two-class society?

The CPI was first published by the BLS in 1919 to help set wage levels for workers in shipbuilding yards, and its use as a standard for wage increases has always been one of its main purposes. Currently about 8 million workers are covered by collective bargaining contracts that provide for increases in wage rates based on increases in the CPI, and these wages set a pattern that millions of other workers try to emulate. More recently, many types of government payments have been linked to the CPI. Among those who reap a windfall if the annual CPI increase is overstated are 31 million social security beneficiaries and 2.5 million retired military and Federal Civil Service employees and survivors. Others receive payments geared to a particular component of the CPI, especially 20 million food stamp recipients and 25 million children who eat federally subsidized school lunches. In all about half the population, including dependents, is affected by changes in the CPI.

The use of escalator clauses has created a two-class society, separating those who are protected against inflation, legally or by contract, from those who are not. Steelworkers, Chicago bus drivers, and other union members enjoying generous escalator clauses have moved several steps up the relative income ladder at the expense

of white-collar workers and others whose wages are not escalated. Social security recipients enjoyed a 14.4 percent boost in benefits in July 1980, as compared to an increase in the government's average hourly earnings index of only 9.2 percent in the year ending that month. Use of that earnings index rather than the CPI for escalation in 1980 would have reduced the federal deficit by about 8 billion. Use of the PCE deflator would have been almost as desirable, saving about \$6 billion.¹ Thus some of the much-discussed financial crisis of the Social Security System results from the use of the CPI for escalation purposes.

While adjustment of payments is the most tangible function of the CPI, there are two other uses which figure prominently in discussions of economic performance and policy. The first and most obvious is that the CPI itself is a readily available measure of inflation and serves as a widely-quoted verdict on the success or failure of economic policy. The second is that the individual CPI item indexes for pork, gasoline, and other products are the sources of other price indexes. The CPI and PCE deflator displayed in Table I are both based on the same price-change data for pork and gasoline, but they combine these individual item indexes with different weights. Because the Commerce Department procedures put less weight on energy prices, which rose rapidly during the 1978-80 period (as well as no weight at all on mortgage interest rates), they yield a slower overall increase when the PCE deflator is added up. It is the PCE deflator, and the broader "GNP deflator" of which it is a major component, that allow the Commerce Department to translate data on current-dollar sales and personal income into quarterly estimates of real Gross National Product, the basic measure of the economy's productive performance.² Real GNP, in turn, is divided by BLS data on hours spent at work to yield data on the nation's hourly productivity.

The ever-changing market-basket

The CPI reports the price in any given month of a so-called "fixed market-basket" of commonly purchased items. Today's price of the

¹ The actual social security increase was based on the CPI change in the twelve months ending in March, 1980.

² About two-thirds of Gross National Product consists of Personal Consumption Expenditures deflated by the PCE deflator. The other third consists of construction spending, business equipment purchases, government wages and purchases of goods, and the excess of exports over imports. Each of these other components has its own deflator based on a wide variety of data sources.

market-basket is expressed relative to what the same items would have cost in 1967, the arbitrary "base year" of the index. As shown on the top line of Table II, the CPI was at a level of 251.7 in September 1980, indicating that items costing \$10,000 in 1967 would have cost \$25,170 if purchased in September 1980. Public attention tends to focus on recent changes in the CPI rather than on the cumulative change since 1967. Thus, newspaper reports do not highlight the index level of 251.7, but rather the change over the past year and month. In September 1980, the change in the CPI over the previous year registered 12.7 percent, and the change from August to September was 1.0 percent, usually expressed at an annual

TABLE II. *A Sample of CPI Item Indexes, September 1980.**

	INDEX LEVEL (1967=100)	PERCENT CHANGE FROM SEPTEMBER 1979
All Items	251.7	12.7
White Bread	219.6	9.4
Sirloin Steak	280.9	11.9
Eggs	179.9	5.4
Potatoes	313.2	57.2
Roasted Coffee	426.1	0.0
Whiskey	137.6	6.7
Residential Rent	195.1	9.0
Contracted Mortgage Interest	500.9	26.3
Fuel Oil	585.4	21.3
Telephone Services	137.0	3.5
Television	105.0	2.0
Women's Dresses	168.5	-1.5
New Cars	181.7	9.4
Airline Fares	310.3	44.9
Hospital Room	428.4	13.8
School Books and Supplies	221.0	9.7

* Source: *Consumer Price Index Detailed Report*, September 1980.

rate. The sense of panic that surrounded the Carter Administration's economic policy in March and April of 1980 was directly set off by three consecutive monthly CPI increases of 1.4 percent, or 18.2 percent when expressed as an annual rate.

The task of constructing the CPI involves (1) determining what people buy, (2) determining where they buy, and (3) determining what they pay for what they buy. The first task was carried out by the BLS and Census Bureau in 1972-74 and involved quarterly interviews with about 20,000 families and a survey of another 20,000 families who were asked to keep diaries of small, frequent purchases for two weeks. Because this effort of carrying out the Consumer Expenditure Survey is so complex and expensive, Congress is only

willing to allocate funds for such a survey every decade. The previous Consumer Expenditure Survey had been carried out in 1960-61 and was the basis of the CPI until 1977. Thus in late 1977 the "old CPI" was based on expenditure data that were sixteen years out of date, and the "new CPI" introduced in 1978 was based on an expenditure survey that was already five years out of date.

Determining where people buy, so that the right amount of information might be collected from particular retail outlets, discount stores, and mail-order houses, was accomplished by a "point-of-purchase" survey of another 23,000 families in the early 1970s. This scientific basis for the collection of price data represents a substantial improvement on the arbitrary choices of outlets in the CPI for earlier years. With the allocation of individual items and retail outlets established by these various surveys, the month-to-month job of collecting the actual price quotations is carried out by BLS data collectors who have considerable latitude to choose the specific brands and types of goods to be priced each month within the general item definitions laid down by the central BLS office. An incredible total of one and a half *million* individual price quotations are obtained each year, of which 700,000 are for food, 100,000 are for rent and property taxes, and the remainder are for other items. Data sources, called "reporters," include about 2,300 food store outlets, 18,000 rental units, 18,000 housing units, and 22,300 other sources.

The importance of weighting procedures

Every month the CPI publishes an overall index, summary indexes for major groups of items like food and apparel, and about 250 item indexes, a few of which are shown as examples in Table II. What is striking here is the wide variety of price increases registered by different items since 1967, ranging from 5 percent for television sets to 485 percent for fuel oil. Clearly the overall inflation rate registered by the CPI depends on how much weight is attached to each item. Someone who spends equal shares of his income on rent, TV sets, telephone calls, eggs, and whiskey, would have experienced a price increase since 1967 of only 51 percent, or a compounded rate of only 3.2 percent per year. Someone else who spends equal shares on steak, potatoes, coffee, fuel oil, and mortgage interest, would have experienced an increase since 1967 of 321.3 percent, or a compounded rate of 11.7 percent per year. Since average hourly earnings increased by 7.5 percent over the same period, the

first spending pattern would have allowed a substantial increase in real income, whereas the second pattern would have resulted in a drastic drop in real income.

Consumers are under constant pressure to shift their spending patterns to avoid goods that have unusually high price increases—for example, to reduce fuel usage in favor of wool sweaters, or to shift from coffee to whiskey. Any index like the CPI that uses fixed expenditure weights must exaggerate the inflation rate as compared to an index like the PCE deflator that uses current weights, since the CPI assigns relatively large weights to high-inflation items like fuel oil and coffee based on their shares in consumer expenditure in the “good old days” of 1972-73, before the consumer reaction against their increase in price. The fixed weights used in the CPI would not be an important defect if all products changed in price by roughly the same amount over long periods of time. But the large variety of price changes between 1967 and 1980 displayed by the index numbers for individual items in Table II has made the fixed-weight problem a source of upward bias in the CPI during the past three years, as obsolete weights magnify the high inflation rates of products like fuel oil.

How much of an exaggeration in the CPI's measured inflation rate is caused by this so-called “substitution bias”? We do *not* learn the answer to this question by examining the massive differences between the CPI and PCE deflator displayed in Table I, since these are largely caused by other factors besides substitution. Instead, we can determine the contribution of consumer substitution away from high-inflation items by examining the effect of three different weighting schemes for the data used in the PCE deflator. The first is the scheme used in the published “implicit PCE deflator” itself. Table III shows an example of how the implicit PCE deflator would be calculated for a simple economy consisting only of spending on coffee and whiskey. Sections 1 and 2 exhibit prices and quantities in three different periods: the 1972 base period and two successive quarters in 1980. Section 3 multiplies price times quantity in each period to obtain actual expenditures. Section 4 then computes “real” expenditures in constant 1972 prices by multiplying the *actual* quantities purchased in each period by the constant prices of 1972.

The PCE deflator is simply defined as the ratio of actual expenditures to real expenditures, and this is written in section 5, along with the percentage change between periods. This extreme example reveals a defect of the PCE deflator, which uses weights that shift each period. The alteration in weights in successive periods causes

TABLE III. *Methods of Calculating Price Indexes (for a Hypothetical Economy)**

	1972	1980	
		FIRST QUARTER	SECOND QUARTER
THE HYPOTHETICAL ECONOMY			
1. Prices			
Coffee per pound	\$ 1	\$ 4	\$ 5
Whiskey per bottle	\$ 5	\$ 5	\$ 5
2. Units Sold			
Pounds of Coffee	5	3	2
Bottles of Whiskey	1	2	3
3. Actual Expenditures			
Coffee	\$ 5	\$12	\$10
Whiskey	\$ 5	\$10	\$15
Total	\$10	\$22	\$25
4. Real Expenditures in 1972 prices			
Coffee	\$ 5	\$ 3	\$ 2
Whiskey	\$ 5	\$10	\$15
Total	\$10	\$13	\$17
THE EFFECTS ACCORDING TO THREE INDEXES			
5. Implicit PCE Deflator (percentage change)	100	169	147
6. Chain Index of 1980 change		69.0%	-13.0%
7. 1972 Fixed-weight Index (percentage change)	100	250	300
		150.0%	20.0%

Notes: The implicit PCE deflator in section 5 is 100 times the ratio of total actual expenditures (section 3) to real expenditures (section 4).

The Chain Index in section 6 multiplies the price change for the second quarter of 1980 for each item (25 percent for coffee, zero for whiskey) by the average expenditure share of each product in *both* quarters of 1980 (22/47 and 25/47, respectively).

The Fixed-weight Index in line 7 multiplies the level of the item index for each period (100, 400, and 500 for coffee; 100 each period for whiskey) by that item's share in 1972 expenditures (50 percent for each product in this case).

the deflator to mix up the measurement of price changes with the effect of shifting weights. Thus, in the second quarter of 1980 the price of coffee increases by 25 percent, and the price of whiskey stays constant, but the PCE deflator registers a 13 percent *decline* in spite of the fact that no single price has dropped! Why? Expenditures in that quarter have shifted toward whiskey, which has had no price increase at all since the base year of 1972; thus the higher weight increases the influence of whiskey's *cumulative* absence of price change since 1972, which has nothing to do with actual inflation in 1980.³

How can we obtain the advantage of the up-to-date weights used

³ If the same example were recalculated for a deflator using a base of 1980, second quarter (rather than 1972), the result would be an increase in the deflator of 14 percent rather than a decline of 13 percent.

in the PCE deflator without the deflator's disadvantage of mixing together price changes and weight changes? This is accomplished by the "chain index," which is calculated by averaging together the *changes* in individual prices between periods rather than by computing an index *level* as in the case of the implicit deflator. These individual price changes are weighted by the average share of expenditures of each category in the two adjacent quarters taken together. In our example the increase in the chain index is 11.7 percent (shown in section 6), which makes intuitive sense as an average of the 25 percent increase in the price of coffee and the zero percent increase in the price of whiskey. (Since the share of expenditures on constant-price whiskey is a bit more than half in the two quarters, \$25/\$47, the chain index comes out showing a bit less of an increase than a simple unweighted average of 25 and zero).

Finally, the third alternative is to combine the coffee and whiskey prices with fixed 1972 expenditure weights. This creates an index analogous to the CPI. As shown in section 7, the fixed-weight index yields a 20 percent price increase for the second quarter of 1980, reflecting the higher weight of coffee in 1972 spending patterns. In this extreme case the bias in the fixed-weight index stemming from consumer substitution is represented by the difference between the 20 percent increase in that index compared to the 11.7 percent increase in the chain index.

While real-world price changes vary all over the map, the relatively large share in spending of items experiencing roughly average price increases makes the problem of consumer substitution in the actual CPI less important than in our extreme example. This is shown in Table IV, which displays an array of price change indexes, ranging in order from the implicit PCE deflator in section 1 to the CPI itself in section 5. The five indexes here allow us to decompose the difference between the implicit PCE deflator and the CPI into three main factors. The chain index in section 2 differs from the implicit deflator in section 1 by eliminating the undesirable impact of changing weights, thus the difference between section 2 and section 1 shows the modest quantitative impact of shifting weights. Next, section 3 lists the PCE deflator recalculated with fixed 1972 weights. The difference between this fixed-weight version of the PCE deflator and the chain index in the section above shows the effect of consumer substitution away from items with rapidly rising prices. The difference is negligible in 1977 and 1978 but became magnified in 1979 and 1980, largely due to the over-weighting of energy prices in the fixed-weight index. Nevertheless,

TABLE IV. *Five Measures of Inflation, 1977-80**

	LATE '76- LATE '77	LATE '77- LATE '78	LATE '78- LATE '79	LATE '79- MID '80
1. PCE deflator	5.6%	7.4%	9.9%	11.6%
2. PCE deflator with "chain weights"	6.0	7.8	10.3	11.9
3. PCE deflator with "fixed weights"	5.9	7.9	10.7	12.4
4. CPI with PCE treatment of home ownership	6.3	7.9	10.8	12.2
5. CPI	6.8	9.0	13.3	16.0

* Source: Alan S. Blinder, "The Consumer Price Index and the Measurement of Recent Inflation," *Brookings Papers on Economic Activity*, vol. 11 (1980, no. 2), Tables II, IV and VI.

Note: CPI figures are for December through December, or December through June in the last column. PCE deflator figures are for fourth quarter through fourth quarter, or fourth quarter through second quarter in the last column.

in the first half of 1980 shifting weights and the substitution effect together contributed only 0.8 out of the 4.4 percentage point difference between the Consumer Price Index and the implicit PCE deflator.

Accounting for home ownership

The bulk of the excessive inflation rate measured by the CPI can be explained by its bizarre treatment of home ownership. Section 4 displays a special version of the CPI that replaces the actual home ownership component by the PCE measure and weighting of home ownership cost. The difference between the actual CPI in section 5 and the special version in section 4 shows that the choice of home ownership treatment makes an enormous difference, a full 3.8 percentage points in the first half of 1980.

Far from being a source of higher prices, squeezed budgets, and falling living standards, most Americans have found home ownership to be a source of wealth creation and one of the few spots in the family budget that is largely insulated from inflation. The treatment of homeownership in the CPI makes the fatal error of treating the whole population as if it were in the predicament of a newlywed couple buying its first house. This unlucky pair, late arrivals on the housing inflation merry-go-round, over the past several years has indeed faced a substantial increase in the monthly payment required to own its first house. But the vast majority of home owners has been protected from these higher costs. Increases in home purchase prices for existing home owners are a source of higher wealth, and "leverage" (the small initial share of their down-payment equity) makes the value of their equity increase by a multiple of the per-

centage annual increase in house prices. Because income is properly defined as consumption plus the change in one's wealth, higher home prices by this definition also raise individual incomes. Increases in mortgage interest rates do not represent a higher cost for holders of existing mortgages, since most of these were negotiated at fixed interest rates. The monthly payment to the local savings bank is the same today as it was in the month of the first payment when the house was purchased two or five or fifteen years ago, and thus is a steadily falling proportion of annual earnings that allows the paycheck to be diverted to other needs. Home ownership has been a blessing—a source of wealth and six-figure balance sheets for many Americans—rather than the curse that the CPI's treatment would imply.

In Table V the housing component of the PCE deflator is compared with the various parts of the rent and home ownership component of the CPI. It is evident that the difference between the PCE and CPI treatments involves both the weights and the actual price increases registered by the individual components. The housing component represents 17.4 percent of the weight in the PCE deflator,

TABLE V. *Rent and Home Ownership Costs: CPI Weights and Price Increases**

ITEM	WEIGHT IN TOTAL INDEX, DECEMBER 1979 (PERCENT)	ANNUAL RATE OF CHANGE SEPTEMBER 1979- SEPTEMBER 1980 (PERCENT)
A. PCE Deflator Housing Component	17.4%	9.0%
B. CPI Components		
1. Residential Rent	5.3	9.0
2. Home Ownership	24.9	16.8
Home purchase	10.4	13.8
Contractual mortgage interest cost	8.7	21.8
Property taxes	1.7	3.5
Property insurance	0.6	13.6
Maintenance and repairs	3.4	9.0

* Sources: CPI: Same as Table II. PCE Deflator: *Survey of Current Business*, October 1980. PCE data refer to the quarter in which the indicated month occurred.

as contrasted with the 30.2 percent weight for rent and home ownership together in the CPI. The increase in the PCE component in the year to September 1980 was only 9.0 percent, as compared to a weighted average of 15.4 percent for rent and home ownership together in the CPI. There are numerous weak points, both major and minor, in the CPI treatment of housing. The most important

are (1) the overweighting of the home-purchase and mortgage-interest-rate components, (2) the treatment of existing mortgage contracts as involving variable rather than fixed rates, and (3) the failure to subtract from the higher home prices and mortgage rate the *benefits* that consumers receive from interest tax deductions and from the capital gains due to higher house prices.

1. *Overweighting of home purchase prices and mortgage interest rates.* Table V shows that the weight attached to mortgage interest is almost as large as that attached to home purchase. The CPI makes the incredible error of treating home purchase and mortgage interest payments as separate unrelated transactions; it counts the house price once as the weight for home price changes and then counts most of it *again* as the weight for changes in mortgage interest rates. This double-counting can be appreciated in an example involving a new home purchased for \$40,000 in 1972, financed by a 20 percent down payment (\$8,000) and a twenty-five-year \$32,000 mortgage taken out at a typical 1972 interest rate of 7.5 percent.⁴ The BLS procedure computes the weight for the purchase price component from the 1972-73 consumer expenditure survey based on purchases of newly constructed houses; if every survey respondent had annual consumption expenditures of \$20,000, and 5 percent of them purchased a new \$40,000 house, this would yield a weight for home purchase of 10 percent. But that is not all. Fully half of the mortgage payments over the 25 year term (\$26,429, in this case) is included as an *additional* expenditure, so that mortgage interest costs receive a weight of 6.6 percent in this example. A minimum requirement for consistency in the CPI should be that the weight on housing reflects the amount actually spent—\$40,000 in this case. People do not buy houses and mortgages separately; they obtain mortgages so that they do not actually have to lay down \$40,000 in cash!

2. *Assumption of variable rates on all existing contracts.* The CPI does not describe the housing-cost experience of actual U. S. homeowners but rather of a fictitious society in which the interest rate on all outstanding mortgages is renegotiated every month. Imagine that the average mortgage lasts 10 years, and that the mortgage rate has risen in the past decade from 5 to 15 percent at a pace of exactly one-twelfth of a percentage point every month. Then the average rate paid on outstanding contracts would be 10 percent. Now imagine that on January 1, 1981, the rate on mortgage closings suddenly jumps from 15 to 17 percent. The CPI uses the mortgage

⁴ This example is taken from the article by Alan Blinder cited in the note to Table IV.

closing rate for the first five days of the previous month, and so in this example the mortgage component of the February 1981 CPI would show an increase of 13.3 percent. If all other items were increasing at an average of 1 percent per month, or 12.7 percent per year, this treatment of the mortgage interest rate would be enough to cause scare headlines, since the annual rate of increase of the all-items CPI in February would be *27.9 percent*. But in truth, since a single month is initially involved and the average mortgage lasts for ten years, less than one percent of total mortgage payments are affected by the new rate. The average mortgage interest rate paid would change from 10.0 to 10.1 percent, for an increase of just one percent, exactly the same as the assumed increase in all other items. Scare headlines would be avoided, and the February announcement of the CPI would report an annual rate of increase of 12.7 rather than 27.9 percent.

3. *Use of actual rather than real after-tax interest rate.* Does a higher mortgage interest rate actually raise the true cost of borrowing, as assumed by the CPI? Not necessarily, because borrowing cost consists of the actual interest rate paid, less the percentage increase in the price of the item purchased with the borrowed funds, less any tax deductions for interest paid. Sensible home owners and business borrowers know that a 15 percent interest rate is not a suffocating burden if borrowing allows them to buy cheap now and sell dear later. In fact it is easy to show how an increase over a decade from a 5 to 15 percent mortgage rate actually could have *reduced* real borrowing costs. Imagine that over the same period the inflation increased from zero to 10 percent, and that the income tax rate remained fixed at 20 percent. Since all interest paid (not just the net-of-inflation part) is deductible, the *real* cost of borrowing can decline if inflation is high enough.

The home-ownership blunder, and how to right it

There are no defenders of the present treatment of home ownership costs in the CPI, which has remained essentially unchanged since 1953.⁵ Yet year after year between 1977 and 1980 its damage

⁵ In January 1981 the BLS announced that "the much-criticized home-purchase component of the consumer price index will be deleted and will probably be replaced with an estimate for rents" (*New York Times*, January 29, 1981, p. 1). This announcement thus endorses the conclusion of this section (written before the announcement) that the "rental equivalence" method should have been used all along. Unfortunately, the change will not be made until 1985, so this section of the text remains relevant for the first half of this decade.

grew as escalated union wages, government transfer payments, and the government deficit were pushed up. During the deliberations that led to the 1978 CPI revision, there was unanimous staff support in BLS for killing the present procedure. Yet the staff was overruled by the late Julius Shiskin, then Commissioner, who wrote that "I have decided that the present treatment will be continued. . . . This decision is based on the fact that there is widespread disagreement among the business, labor, and Government advisers to the Bureau of Labor Statistics concerning the approaches to the cost of shelter proposal by the Office of Prices and Living Conditions."⁶ One interpretation of this remark is that the last refuge of a bureaucrat faced with controversy is to retain the status quo. Another possibility is that the key word in Shiskin's letter is "labor," and that labor unions were unwilling to accept any tampering with the CPI that might jeopardize the privileged position that they had enjoyed during the 1973-74 high-inflation period thanks to their CPI-escalated contracts. In light of the fact that the Carter Administration bowed to union pressure on the issue of the minimum wage, it is not implausible that union pressure was behind Shiskin's decision. In any case there is no doubt that labor unions have been among the main beneficiaries of his vote for the status quo.

The two main candidates suggested by economists to replace the present treatment are the same as those proposed by the BLS staff during the 1972-77 deliberations on the CPI revision—the "user cost" and "rental equivalence" approaches. In fact, in an end run around its own index, the BLS now publishes five alternative versions of the CPI using different measures of home ownership cost. Of the five alternatives, four represent different ways of treating user-cost, and the fifth is based on the rental equivalence method. (It is the fifth alternative that is displayed on line 4 of Table IV.)

1. *The user-cost of housing.* Economists love to dazzle their students with "user cost" formulas of the type developed in the early 1960's by Harvard's Dale Jorgenson for the purpose of explaining business investment behavior. The aim is to come up with a figure to represent the amount for which a capital good could be rented. Unlike the present CPI approach, which is based on the current price paid for new houses by the small fraction of people who actually purchase them in a given year, the user-cost approach measures the current annual capital and operating cost of home ownership for *everyone*. User-cost formulas typically sum up the annual mortgage interest

⁶ Letter from Julius Shiskin to Lyle Gramley of the Council of Economic Advisers, April 15, 1977.

costs, plus the interest that would have been earned on the down payment if it had been invested in a financial asset, plus operating costs like taxes, insurance, and repairs, minus capital gains due to higher house prices, and minus tax deductions made possible by the payment of mortgage interest.

The basic problem with the user-cost approach is that there are several alternative ways of measuring the ingredients in the formula, especially interest rates, tax rates, and capital gains. Are capital gains to be counted as those expected when the mortgage was taken out or those actually realized? Is the mortgage interest rate to be the current rate or an average of past rates? How is the personal tax rate relevant for mortgage interest deductions to be determined? The BLS provides four different measures of user cost to provide a menu of outcomes, and all of them display much more volatility than actual rent. If an economist's approximation of how much a house should rent for does not behave at all like actual observed rents, then that ought to be telling him something.

2. *Rental equivalence.* The idea of rental equivalence is simple and in fact is already used in the PCE deflator: Simply assume that the cost of home ownership moves in proportion to actual rents as measured by the CPI rent index, and apply a weight based on the estimated rental value of owner-occupied homes. Residential rent has increased more slowly than the average for other CPI items, and much more slowly than the present CPI home ownership component. Objections to the rental equivalence approach center around the fact that most single-family homes are not rented, and so the rental information collected by the CPI may not reflect hypothetical rents of single-family homes. Nevertheless landlords face the same interest costs as home owners and enjoy roughly the same tax deductions and capital gains. The fact that actual rents exhibit more gradual changes than hypothetical user-cost measures does not necessarily imply an error but rather reflects the tendency for prices of physical goods and services to adjust more slowly to changing conditions than prices of financial assets. Just as a company's stock price typically jumps around much more than the prices of the things it sells, so housing prices and interest rates jump around more than the rental value of houses. This makes sense in the case of rent, since changes in current mortgage interest rates do not actually affect landlords who have long-term fixed-rate mortgages, and changes in current capital gains have no impact (except on paper wealth) if the building is going to be held over a long period rather than sold at today's price.

Since the rental equivalence method is appealing, why not just adopt it? Use of rent data for the CPI home ownership component would justify expanding the sample of rent information to include more single-family houses. I suspect that much of the resistance to the rent approach stems from a belief that rent data are tainted, since rents have been rising so much less rapidly than the cost of construction (95 percent vs. 192 percent, respectively, between 1967 and 1980). But there is an economic reason for this divergence. My parents recall renting a house in Berkeley, California, in 1938 for \$65 per month that was also for sale at the same time for \$7,500. The house now would sell for \$250,000 but could not rent for \$2,167 a month (an equivalent percentage of sale price). In fact, a rent below \$1,000 would be typical for that kind of house in the current Berkeley rental market. Why? Landlords and home owners renting out their homes no longer have to recoup all of their cash mortgage interest and operating expenses from rent, since lightly taxed capital gains and tax deductions on mortgage interest now pay part of the bill. Thus the slow increase in rents is not a fiction, but reflects economic reality.

Accounting for changing quality

Up to this point all of the issues have involved differences between the CPI and PCE deflator. But now we turn to the question of the changing quality of products, where both indexes are on the same footing because they use the same underlying price figures obtained by the BLS data collectors. When a new model of a product is introduced that contains one or more extra features, part of its higher price may be explained by its higher quality. The gradual acquisition of higher quality goods has been an important source of a rising standard of living for Americans, and so we must make sure that adequate adjustments are made for the fraction of price increases that actually represent higher quality.

Quality change poses a problem for the CPI, which attempts to measure changes in the price of goods and services in a fixed market basket. The apparently straightforward task of collecting information on the price of a fixed set of goods is continually complicated by the fact that some goods go out of existence to be replaced by new models or new products. The issue of quality adjustments involves precisely how and when the new models are introduced into the overall index.

Over its history the CPI market basket has continually changed,

providing an interesting—though usually out-of-date—commentary on social history. From 1918 to 1940, the CPI index that covered shaving was the price of a barber shave, and then switched in 1940 to the safety-razor blade, despite the fact that safety razors had largely replaced barber shaves in the 1920's. From 1940 to 1952 the index item was the blade, joined from 1952 to 1964 by shaving cream, followed from 1964 to 1977 by the shaving cream alone, followed since 1977 by a combination of dental and shaving toiletry products. Since 1964 there has been no blade in the CPI, and thus no consideration of the new world opened up for most men by the invention of the double-edged blade in the early 1970's.

Other products have come and gone as well. In 1940 the index dropped not only barbershop shaves, but also high button shoes, men's nightshirts, and girls' cotton bloomers. The 1953 revision eliminated salt pork and laundry bar soap but added televisions, frozen foods, Coca-Cola, and whiskey. Pajamas, which had replaced nightshirts in 1940, themselves disappeared in 1964, leaving only sheets and blankets to cover the sleeping American male. Appendectomies also disappeared in 1964, the year funeral services were added. Among the new product categories introduced in the 1978 revision were pet supplies and expenses, indoor sports equipment, tranquilizers, and electronic pocket calculators.

How are new models and products introduced into the CPI? There are three main methods.

1. *Direct comparison.* When a quality change is considered to be "small," in the judgment of BLS staff members, it is neglected. All of the observed price change would be recorded as a change in the CPI item index, with no adjustment for quality change. If we assume that most model change-overs involve quality improvements, the direct comparison method imparts an upward bias to the CPI—that is, causes it to register too much inflation.

2. *Linking.* When the BLS staff members assess the quality change as too important to be ignored, then they introduce a linking procedure. This effectively imputes to the product whose quality changed the price movement of similar goods whose quality did not change. Let us imagine that an old-fashioned cotton sheet selling for \$5.00 is replaced by a polyester permanent press sheet selling for \$8.00 which lasts twice as long. The CPI linking procedure pays no attention to increased durability, but simply replaces the observed price increase by the actual price increase of other unchanged items in the same "household linens category."

3. *Cost data.* In some cases the BLS obtains the cost of the quality change directly from the manufacturer. First, staff members must determine whether a change claimed by the manufacturer to improve quality actually does so. The criterion for the judgment is whether the change improves the value of the product for the user. (Several years ago the BLS would not include a change by an auto manufacturer from a dial to digital clock on the grounds that this change did not increase the "user value" of the automobile.) The value of those quality changes that are not disallowed is based on the manufacturer's estimate of the extra cost involved in making the higher-quality item. This procedure is obviously subject to the flaw that the manufacturer may overstate the cost of the quality improvement in order to disguise a portion of actual price increases, particularly in a period in which government price controls or guidelines are attempting to hold a lid on prices. This source of error would tend to bias the CPI downward and cause it to register too little inflation.

The automobile is the only product which is given the full-blown cost-adjustment treatment. Every September several BLS officials travel to Detroit to consult with the major manufacturers in order to identify those specification changes on new models for which adjustments must be made. If a producer has introduced a new, heavier bumper, whether on its own initiative or to comply with federal safety regulations, the firm is asked to supply an estimate of the difference in the cost of producing the new bumper as compared to the old bumper. This difference in cost is then subtracted from the reported price increase of the new model automobile.

Because the BLS devotes so much more attention to automobiles than to other products, there is a chance that the recorded differences between the inflation rates registered by autos and other products may reflect differing quality-adjustment procedures rather than a true difference in price behavior. For instance, between 1972 and 1978 the measured price of automobiles went up 27 percent, but the price indexes for other types of moving mechanical equipment like tractors and construction machinery (part of the Producers' Price Index compiled by the BLS) increased by about 80 percent.

Product price cycles and increased performance

The typical product, whether automobiles in the 1920's, TV sets in the 1950's, or electronic calculators in the 1970's, experiences after its invention an initial period of declining price, as its man-

ufacturers spread the fixed cost of its development over more and more units sold. Then, as a product becomes "mature," there is less opportunity for efficiency gains to cancel out increased wages and other costs, so prices begin to rise. Three aspects of CPI procedures cause it to understate quality improvements and to overstate price change. First, the use of obsolete weights from decade-old expenditure surveys tends to place too little weight on modern products where price increases are relatively slow—this "consumer substitution" problem was examined above. Second, new models and products are typically introduced into the index much later than the date when their sales volume becomes important. And finally, the linking procedure, by far the most common quality-adjustment technique used by the BLS, tends both to treat new products as if they were mature products and to ignore performance improvements.

The long intervals between CPI revisions, and the officially sanctioned tendency for data collectors to cling to existing models until they disappear from the marketplace, imply that items with declining prices are typically absent from the index. Albert Rees, who in 1960 performed a fascinating comparison of BLS item indexes with price data for the same products from mail-order catalogues, recalls with amusement a visit with a store owner to identify the particular model cooking pot that was then being priced by a BLS field representative. "Oh, you mean this old model up here on the top shelf? We never sell these any more," answered the store owner, "but that BLS field representative keeps asking us for its price."

More important are the new products that enter the CPI late in the product price cycle. The United States became a motorized society in the 1920's and 1930's, when there was an enormous improvement in the performance of automobiles along with a decline in their price—but the automobile was not included in the CPI until 1940. Penicillin entered the CPI in 1951, after it had already experienced a 99 percent decline from its initial price. The pocket calculator entered the CPI in 1978, after it had declined in price about 90 percent from early 1970–71 models and about 98 percent from the price of a comparable electromechanical desk calculator of the 1960's.

The linking procedure misses quality improvements for two reasons. First, as in the cotton sheet example, the price change is taken to be identical to other items in the sample product group that remain unchanged in quality. But these are likely to be mature products experiencing price increases, whereas the item that is improved in quality is more likely to be in the early stage of its product cycle.

Perhaps more important, the CPI ignores changes in performance that tend to accompany model changes. In the cotton sheet example, the new sheet lasts twice as long. Since consumers presumably are buying years of service from long-lasting items like sheets, the CPI treatment ignores the lower price of a "sheet-year," since the service life in the example is assumed to double while the price only increases by 60 percent. (It is a sign of the times that many goods like sheets and draperies are officially classified as "nondurable" yet actually last longer than many "durable" goods.)

The most striking fact about the treatment of quality change in the CPI is that it is inconsistent with its own stated objective, which is to adjust for changes in quality when they improve the value of a product to the user. In the sheet example and in many others there is no attempt to measure the change in product performance. Consumers value sheet-years, motor-oil-miles, and tire-miles, rather than sheets, quarts of motor oil, and tires independent of their durability. F. Lee Moore has calculated that between 1935 and 1978 the price of tires per mile of tire-life declined by 9 percent, in contrast to an increase in the CPI tire index of 140 percent. Over the same period, the price of motor oil per mile declined by 52 percent as compared to an increase in the CPI of 234 percent.⁷ There are other examples of improved performance that are missed by the CPI's attention to "price per item" instead of "price per service desired by the user." Among these are the increased service life of light bulbs, spark plugs, and appliances.

Our previous discussion of the user cost of housing can be applied more broadly to any good which lasts a significant length of time. Consumers care about the total annual operating costs of automobiles and appliances having a given level of performance, not purchase price alone. Auto manufacturers have diverted development efforts from the old concentration on styling and tailfins to a new obsession with increased fuel efficiency. Yet there is no procedure in the CPI to adjust for improvements in automobile fuel efficiency.⁸ A lab at M.I.T. several years ago studied the repair records of appliances and found that the frequency of refrigerator repairs had dropped by a factor of two, and TV repairs by a factor of four, between the mid 1950's and early 1970's. In a study that makes al-

⁷ F. Lee Moore, "Index Mischief: Price versus Cost," *Electric Perspectives*, 1978, no. 5, pp. 8-27.

⁸ In the case of automobiles the BLS has measured the price change on new downsized models as equal to models that are unchanged in size. This is the correct procedure if the fuel savings on the new models just balance the consumer value of the loss in comfort and performance, but not otherwise.

lowances for improved electricity efficiency and other characteristics, I have estimated that the quality-adjusted prices of refrigerators, washing machines, and air conditioners declined at about twice the rate registered by the CPI between 1950 and the mid 1960's.

Performance improvements are not just limited to goods, but also extend to services. That vanishing breed, the domestic household worker, now accomplishes more per hour with modern appliances and fabrics than her 1925 counterpart, yet her "price" is a straight hourly wage. The apparently outrageous increases in hospital room charges exhibited in Table II disguise improvements in the quality of medical care provided to the typical patient, and today's guest at a Holiday Inn or other medium-priced hotel enjoys telephone and television service that was unavailable to his luxury-hotel counterpart of 50 years ago. An airline passenger mile is a more comfortable, faster, and safer commodity than it was in 1955, and yet the CPI prices a homogeneous passenger mile. There is no doubt that train service has deteriorated, but this is of minor importance in an index that keeps its weights up to date.

Of all products in the U.S. economy, the one displaying the fastest rate of price *decline* throughout the entire postwar era has been the electronic computer. Yet the U.S. government does not compile a price index for computers, so that the output and productivity gains achieved by companies like IBM and the office machinery industry as a whole are not captured by aggregate indexes of output and productivity. This does not involve the CPI directly, because until recently few computers were sold directly to consumers. Government officials are quick to admit that IBM's output and productivity achievements are missed in official data in the year the computers are manufactured, but they claim that the higher efficiency made possible by computers is accurately captured when they are used in subsequent years in the production of consumer goods. This position is partly true, since the use of computers to replace workers in consumer-goods factories has contributed to measured productivity advances.

Yet for a wide variety of consumer services the CPI is not capturing the improvements that the computer has provided. On many airlines computers make possible pre-reserved seats and one-stop check-in, and airline managements were willing to invest in computerized equipment in the belief that consumers would value the extra services provided. Yet the CPI does not value the extra services, treats an airline passenger-mile as an unchanged commodity, and leaves the impression in our national data that the investment

in the extra computer has produced nothing. The same point applies to 24-hour money machines provided on street corners by banks, and other financial services. It is doubtful that the worldwide convenience made possible by major credit cards would have occurred without the computer, yet the CPI ignores the saving of time and fees by consumers who no longer have to purchase so many travelers checks and letters of credit.

Even the much-criticized U.S. government has been a source of an unmeasured improvement in our standard of living. For 25 years we paid an increased gasoline excise tax, treated by the CPI as an increase in the price of gasoline, in order to finance construction of the interstate highway system. Automobile travel is now faster and safer, but this government activity is treated as having only costs, with no benefits.

The interstate highway example is interesting because it conflicts with a controversial decision that treats anti-pollution and safety devices on automobiles in the CPI as an increase in quality rather than an increase in price. Government environmental and safety legislation is treated as having wisely balanced the cost of the devices against the benefits received by the nation as a whole in reduced pollution and greater safety, in contrast to the interstate highway case where benefits are ignored. If government regulatory efforts, like most economic activities, are subject to increasing costs and diminishing benefits as more and more of the pollution is eliminated, then the CPI treatment may have been conservative a decade ago, in the early stages of regulation, but overly generous recently. The growing consensus that many recent government regulations do not provide benefits to balance their costs would imply that, at least for this one reason, the Consumer Price Index understates inflation.

As we plunge further into the murky depths of index-making, at some point we leave the realm of the statistician and enter the realm of the philosopher. Where do we draw the line between a new model of an old product and an entirely new product? The CPI states that the price of admission to movies increased 330 percent between 1948 and 1978. Yet the invention of television allowed the price of two hours of movie-like entertainment to decline substantially, even if we cancel out the agony of commercials against the saving in baby sitters, parking fees, and transportation expenses. A long list of such broadly conceived substitutions could be compiled—permanent press clothing for commercial laundries, phone for mail, appliances for domestic servants.

A better index

The CPI is a severely flawed index, as shown both by our comparison with the PCE deflator and our examination of the pervasive nature of unmeasured quality change. Yet it is striking that the BLS spent \$50 million during 1972-77 to revise the CPI without curing any of its major defects. In a six-month overlap period in early 1978, the expensively revised "new CPI" registered an increase that differed from the "old CPI" by only 0.1 percentage point.

It seems clear in retrospect that the BLS spent its revision money on the wrong things, improving the number of outlets covered or the number of consumers surveyed rather than investing money in more rent data on single-family homes or on performance data for newly introduced models and products. What the CPI needs, in addition to the use of more up-to-date weights and a rental equivalence approach to the measurement of home ownership costs, is a vastly improved effort to measure the improved performance and efficiency of consumer goods and services, as well as the occasional decline in product quality. Much can be done with existing performance and efficiency data available from the published test reports of Consumers Union and other organizations, and in selective cases the BLS could institute its own testing program or contract for tests from private organizations.

It is now 20 years since a committee headed by George Stigler recommended many of the same improvements in the CPI. It is discouraging that so little has been done by so many for so long. BLS officials tend to reject suggestions for a more imaginative approach to quality measurement as too "subjective," when what is needed is a more frequent application of simple common sense. In the now-classic words of Martin Bronfenbrenner, addressed to the Stigler Committee in 1960, "it is better to be imprecisely right than precisely wrong." And in an era in which each change in the CPI sets off a wave of redistributive adjustments, that observation is precisely right.