ECONOMIC COMMENTARY

Median Price Changes: An Alternative Approach to Measuring Current Monetary Inflation

by Michael F. Bryan and Christopher J. Pike

Price movements are the channel through which market information is transmitted. An increase in one price relative to others is the signal that directs resources and rations consumption. In other words, markets operate through the *distribution* of prices.

Inflation, on the other hand, is a monetary phenomenon that determines the underlying level of all price changes; it has virtually nothing to do with the transmission of market information. Indeed, one fundamental problem with inflation is that it can be confused with relative price movements, obscuring the transmission of market information and reducing market efficiency.[2]

Distinguishing between inflation and relative price movements is also important for the conduct of monetary policy. Without a clear distinction between the two, policymakers may inadvertently react to relative price changes and thereby complicate the economy's adjustment to a new set of prices. By not reacting to changes in the inflation rate, they might allow unnecessary price-level fluctuations.

People who are interested in the current rate of inflation, either for practical or for academic reasons, can consult a variety of measures or price indexes. By far the most popular of these is the

Consumer Price Index (CPI), compiled monthly by the Bureau of Labor Statistics. The CPI measures the average price of an array of goods and services purchased by households, but because it is constructed as a weighted mean of all consumer prices, it does not discriminate between relative price changes and inflation. Indeed, the CPI may rise when the price of just one commodity increases.

This *Economic Commentary* discusses the limitations of mean price statistics as inflation indicators and suggests a well-defined and easily computed alternative — median price changes — as a better signal of current monetary inflation.

■ Inflation and Price Changes

A common textbook definition of inflation is "a rise in the general level of prices." Despite its outward simplicity, this description is a bit vague: The prices of what? And what constitutes a "general" price rise?

The issue of what items to include in an inflation index has been considered at length.[3] The consensus is that measures of inflation should be based on prices of consumer goods and services, since it is the utility arising from these that ultimately defines the prosperity of an economy. If this were the only consideration, the CPI would be a reasonably accurate indicator of inflation. Commodities

The course of economic history is replete with substantial price disturbances. Whenever such disturbances have occurred, two different explanations have been offered. One, common to all disturbances, is that the price movements reflect changes in the quantity of money.... The other explanation has been in terms of some special circumstances of the particular occasion: good or bad harvests; disruptions in international trade; ... and so on in great variety.

Milton Friedman[1]

included in the CPI are weighted according to their share of total household expenditures in some base period, so that changes in the index from one period to the next are broadly reflective of changes in the representative household's current cost of living.[4]

But the strength of the inflation signal in goods and services prices is not necessarily related to an item's share of the typical household budget. As a monetary phenomenon, inflation should influence the price of all goods and services equally. The inflationary signal in the price of a new pair of shoes is theoretically the same as that in the price of

shoe leather or, for that matter, in ⌐ ⌐⌐ ⌐e of cows. There is no reason to expect movements in the price of one to be a clearer indicator of inflation than movements in the prices of the others.

■ The Core Rate of Inflation

To accurately gauge the economy's current inflationary momentum, we must somehow disentangle relative price "noise" from the inflation signal. (It may be that inflation also temporarily affects the distribution of price changes. We will return to this subject in the final section.)

The most common way to reduce the influence of relative price fluctuations on the price index is simply to subtract those goods thought to be affected by temporary or otherwise special factors.[5] The CPI excluding food and energy goods, the index's two most volatile components, is often referred to as the *core* rate of inflation. Clearly, the object of this modified index is to clarify the inflation signal in the price data, because removing food and energy goods, which account for roughly 25 percent of the CPI, substantially alters the index's implied weights and limits its usefulness as a cost-of-living measure.

The problem with this approach is guessing which prices are being influenced by special factors. This introduces more than a little subjectivity into the inflation-monitoring process. Besides, all goods and services prices reflect relative price changes to some degree, and it is impossible to know how persistent these changes will be.

We suggest an alternative statistic — the median consumer price change. The median of a set of data is the value of the middle observation when all items are arranged in either ascending or descending order of magnitude. In effect, the median consumer price change is the CPI less everything but the price change that lies in the middle of the continuum. Since only the order, not the values, of the various price changes is used in its calculation, the median is a central tendency statistic that is largely independent of the data's distribution. The median also has the

intuitively appealing property of lying closer to the majority of price changes than does any alternative measure.[6]

■ The Mean versus the Median

A Recent Example. To illustrate the usefulness of the median as an inflation indicator, consider the distribution of price changes that occurred immediately following Iraq's invasion of Kuwait last year. Table 1 lists, in ascending order, the annualized percentage price changes in the CPI's seven major components between July and October 1990. Rates of price increase varied widely during this three-month period, from a low of 2.3 percent for apparel and upkeep to a high of 27.9 percent for transportation.

We computed three measures of central tendency from these price data: a simple average (in which each of the seven components was weighted equally), an expenditure-weighted average (as used to calculate the CPI), and the median price change.

In the case of a simple average, the annualized aggregate price change over the sample period was 8.4 percent. Note, however, that prices in five of the seven components rose at a substantially lower rate, as the average was heavily influenced by the huge rise in transportation costs brought about by soaring

energy prices. Because transportation costs command a disproportionate share of total household expenditures (17.1 percent), the expenditure-weighted average price change was an even higher 9.1 percent.

The high CPI increases recorded during this period were widely dismissed as a relative disturbance, not a persistent monetary inflation, because the rise in prices originated in energy commodities. Thus, analysts pointed to the CPI less energy goods, at an annualized 4.5 percent, as a better indicator of the economy's inflationary momentum.

Yet while the influence of the energy component was obvious, relative price disturbances were at work in all of the CPI's components, though to a lesser degree. For example, apparel prices during this period were reported to be temporarily depressed by seasonal changeovers, while food prices were said to be down as a result of a larger-than-expected harvest. Medical care costs, on the other hand, were characterized as rising relatively quickly due to escalating insurance expenses. We can minimize the impact of these and other relative price fluctuations on the inflation statistic by disregarding all but the median price change. In our example, this would be entertainment costs, which rose at a 4.9 percent rate.

TABLE 1   ALTERNATIVE CONSUMER PRICE MEASURES, JULY TO OCTOBER 1990

Component	Annualized Percent Change	Share of Household Expenditures (percent)[a]
Apparel and upkeep	2.3	6.1
Food and beverages	3.7	17.9
Other goods and services	4.0	6.3
Entertainment	4.9	4.4
Housing	5.7	42.0
Medical care	10.2	6.2
Transportation	27.9	17.1
Mean change (equal-weighted)	8.4	—
CPI (expenditure-weighted)	9.1	—
CPI excluding energy	4.5	—
Median price change	4.9	—

a. CPI relative importance, December 1989.
SOURCE: U.S. Department of Labor, Bureau of Labor Statistics.

FIGURE 1 MONTHLY CONSUMER PRICE CHANGES

Percent change, annual rate

FIGURE 2 TWELVE-MONTH CONSUMER PRICE CHANGES
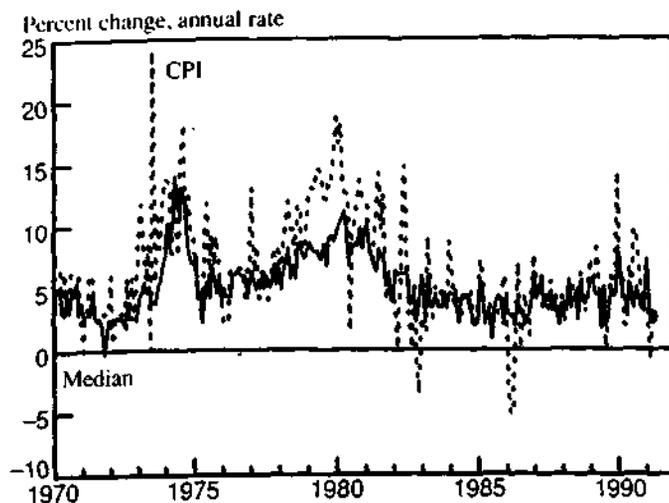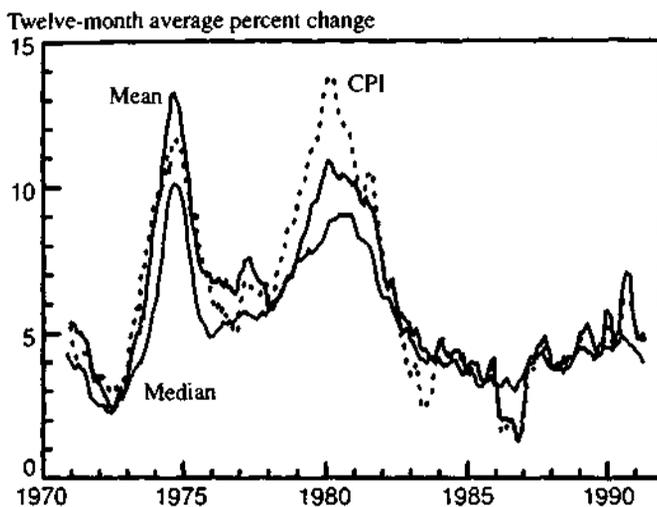
Twelve-month average percent change

SOURCES: U. S. Department of Labor, Bureau of Labor Statistics; and Federal Reserve Bank of Cleveland.

increase brought on by a drought-induced surge in food prices. (In 1973, food prices rose at their fastest rate in more than 50 years, accounting for roughly half of the uptick in the CPI.)

High relative price increases were also seen during the late 1970s, although the distribution of these increases was more balanced (that is, the mean and the median price changes followed more comparable trends). In this case, however, a jump in housing costs, which are weighted at about 20 percent of the CPI, pushed the change in the overall index considerably higher than the mean and median price changes.

Over the past 10 years, these three measures have tracked more closely. Nevertheless, movements in the median change have continued to display considerably less monthly volatility than the mean-derived alternatives. Since 1984, the CPI's annual growth rate has ranged from a low of 1¼ percent in 1986 to a high of more than 6 percent in 1990, as fluctuations in oil prices introduced an important distortion to our interpretation of inflation as measured by the overall index. The median price change, on the other hand, has oscillated within a very narrow 3½ to 4½ percent band over the last six and a half years.

■ Conclusion

Differences between changes in the CPI and the median consumer price change underscore the impact of the distribution of price movements on our monthly interpretation of inflation. The median price change is a potentially useful indicator of current monetary inflation because it minimizes, in a non-subjective way, the influence of these transitory relative price movements.

Whether the median change is an accurate long-run inflation measure is an entirely different matter — one that depends in part on whether monetary inflation causes, or otherwise perpetuates, relative price fluctuations.[9] This is an important area of research that needs to be investigated more thoroughly.

A Historical Perspective. Figure 1 plots monthly changes in the CPI against the median consumer price change (calculated from 35 items) for the January 1970 to July 1991 period.[7] Note that the median price change was substantially less volatile than the CPI, a characteristic that conforms to our intuition that the monetary influence on the price level is relatively stable from month to month.[8]

Although we offer the median price change statistic as a simple and direct way to track monetary inflation in the short run, it is also interesting to note its longer-term patterns. Figure 2 maps the 12-month trend in the CPI, in the median consumer price change, and in the equal-weighted mean consumer price change since January 1971.

Recall that differences between the CPI and the mean change largely reflect the influence of the CPI's expenditure weights on the measurement of inflation, while differences between the mean and the median changes show the degree to which consumer price movements are unevenly distributed. During the inflation acceleration of 1973-74, the CPI and the median change followed similar patterns, while the mean change was substantially larger. In this instance, the distribution of price changes was prominently skewed by a large relative price

It may be that monΨ... inflation and relative price changes are related.[10] One possible linkage may be through a monetary transmission mechanism, whereby changes in the quantity of money influence all prices, but at different times. If fluctuations in the distribution of price changes are predominately monetary in origin, then what economists commonly disregard as relative price noise may actually be leading (or lagging) indicators of a more broadly transmitted monetary inflation. Unfortunately, without a better understanding of how money affects relative prices, we will be unable to recognize and exploit such early warning signals. Moreover, if a monetary transmission mechanism exists, then the CPI is also a biased measure of long-run monetary inflation, since it includes only current, not future, consumption prices.[11] Under these conditions, economists may need to consider asset price indexes, rather than consumer price indexes, for a reliable long-run measure of monetary inflation.

■ Footnotes

1. From Milton Friedman, *The Optimal Quantity of Money and Other Essays.* Chicago: Aldine Publishing Company, 1969, p. 171.

2. A zero inflation policy, then, is not one that prevents *any* price movement. The government could simply adopt such a policy through wage and price controls. This, however, would cause more problems than it would solve, since in the process of repressing inflationary signals, relative price signals are also lost.

3. See, for example, Pierre Fortin, "Do We Measure Inflation Correctly?" in Richard G. Lipsey, ed., *Zero Inflation.* Toronto: C.D. Howe Institute, 1990, pp. 109–30.

4. The current base period is 1982-84.

5. In statistical terms, this is referred to as a *modified* average.

6. While the mean can be thought of as a measure of central *value*, the median is a measure of central *location*. Mathematically, the median minimizes the mean absolute deviation of the data ($\Sigma | x_i - m | / n$), while the mean minimizes the mean squared deviation of the data ($\Sigma [x_i - \bar{x}]^2 / n$), where m is the median and $\bar{x}$ is the mean, for a number of observations, n.

7. These calculations are intended primarily as an illustration. For actual monitoring purposes, a larger, more diverse array of prices (including producer prices) would be desirable. Moreover, the CPI is a weighted mean of prices, not of price changes, so deviations between the percentage changes in the CPI and the mean consumer price change statistic are not entirely due to weighting. The influence of this definitional inconsistency was found to be minimal, however.

8. The annualized monthly standard deviation of the median price change was about 1.9 percent, compared with 3.3 percent for the CPI.

9. By accurate, we mean unbiased. It may be that if skewness in the price data is a consequence of the inflationary process, the median price change could provide a biased estimate of inflation under certain conditions. If so, we would expect such a bias to disappear as the price level stabilizes.

10. For a historical perspective on this relationship, see Daniel R. Vining, Jr. and Thomas C. Elwertowski, "The Relationship between Relative Prices and the General Price Level," *American Economic Review,* vol. 66 (September 1976), pp. 699–708.

11. This idea is discussed at length in Armen A. Alchian and Benjamin Klein, "On a Correct Measure of Inflation," *Journal of Money, Credit and Banking,* vol. 5 (February 1973), pp. 173–91.

Michael F. Bryan is an economic advisor and Christopher J. Pike is a senior research assistant at the Federal Reserve Bank of Cleveland. The authors wish to thank David Altig, John Carlson, and William Gavin for comments on an earlier draft of this article.

Federal Reserve Bank of Cleveland
Research Department
P.O. Box 6387
Cleveland, OH 44101

Address Correction Requested:
Please send corrected mailing label to the above address.