One of the more popularly cited indicators of economic welfare is the so-called core inflation rate. It is often considered a better measure of trend movements in aggregate prices than the overall inflation rate because it tries to eliminate high-frequency fluctuations. Low-frequency price changes are those that largely stem from sustained monetary policy actions and, hence, are more relevant to policymakers trying to gauge trend inflation. While news reports might lead one to believe that there exists a precise measure of the core inflation rate, there is, in fact, no universally accepted definition. In particular, two measures, shown in the accompanying figure with consumer price index (CPI) inflation, are widely used: inflation excluding food and energy (XFE) and weighted median inflation (WMI).¹

The most frequently reported measure of core inflation is CPI inflation XFE. The overall CPI is a measure of the total price that consumers pay for a given market basket of goods and services compared with the base year, and the inflation rate is the percentage change in the CPI from a year earlier.² CPI inflation XFE is calculated as the rate of change in the CPI after food and energy are eliminated from the market basket. Food and energy prices are excluded because they can be highly volatile and difficult to predict.

Popular in academic research, the WMI rate is a second common measure of core inflation. In determining the CPI, each component has an associated weight—the respective proportion of all expenditures that consumers spend on that particular item. The WMI rate is determined by computing the simple monthly rate of change in prices for each component, then ordering the items by their inflation rates, and pairing each with its appropriate weight. WMI is the inflation rate associated with an accumulated weight of 50 percent: In other words, for any month, half of the components have inflation rates higher than the weighted median, while the other half have lower inflation rates. This is an appealing measure of core inflation because it eliminates components with relatively large (and relatively small) changes in prices, which generally do not persist, while the weighted median more closely reflects the persistent trend in price movements.³

Smith (2004) analyzes various measures of core inflation—including the two described here—in an attempt to determine the optimal choice.⁴ She defines core inflation as the best predictor of future inflation, and her tests provide evidence that, of the two, WMI does indeed do a superior job at predicting future inflation, which other economists have also shown. Inflation XFE excludes the same components in every period, even if their individual price fluctuations are not unusual relative to those of other components, whereas the WMI eliminates different components each month, depending on their price fluctuations at that time. Consequently, the latter appears to be a better method to capture the underlying price trend among all expenditures. Therefore, the core inflation rate that we typically read about in the newspaper might not be the one that best forecasts future inflation.

—Kristie M. Engemann and Michael T. Owyang

¹ Alternative measures of core inflation exist—e.g., the trimmed mean. The personal consumption expenditures price index is sometimes used instead of the CPI and is preferred by policymakers.

² The Bureau of Labor Statistics lists the following major groups in the CPI market basket: food and beverages; housing; apparel; transportation; medical care; recreation; education and communication; and other goods and services.


Conventions used in this publication:

1. Unless otherwise indicated, data are monthly.

2. Shaded areas indicate recessions, as determined by the National Bureau of Economic Research.

3. Percent change at an annual rate is the simple, not compounded, monthly percent change multiplied by 12. For example, using consecutive months, the percent change at an annual rate in x between month $t-1$ and the current month $t$ is: \[ \left( \frac{x_t}{x_{t-1}} - 1 \right) \times 1200. \] Note that this differs from National Economic Trends. In that publication, monthly percent changes are compounded and expressed as annual growth rates.

4. The percent change from year ago refers to the percent change from the same period in the previous year. For example, the percent change from year ago in $x$ between month $t-12$ and the current month $t$ is: \[ \left( \frac{x_t}{x_{t-12}} - 1 \right) \times 100. \]

We welcome your comments addressed to:

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Research Division
Federal Reserve Bank of St. Louis
P.O. Box 442
St. Louis, MO 63166-0442

or to:

stlsFRED@stls.frb.org
MZM and M1
Percent change from year ago

M2
Percent change from year ago

M3
Percent change from year ago

Monetary Services Index - M2
Percent change from year ago
### Inflation and Inflation Expectations

- **Percent**

The shaded region shows the Humphrey-Hawkins CPI inflation range. Beginning in January 2000, the Humphrey-Hawkins inflation range was reported using the PCE price index and therefore is not shown on this graph. See notes on page 19.

### Treasury Security Yield Spreads

- **Yield to maturity**

### Real Interest Rates

- **Percent, Real rate = Nominal rate less CPI inflation**

The shaded region shows the Humphrey-Hawkins CPI inflation range. Beginning in January 2000, the Humphrey-Hawkins inflation range was reported using the PCE price index and therefore is not shown on this graph. See notes on page 19.
Monetary Trends

Short-Term Interest Rates

Long-Term Interest Rates

FOMC Intended Federal Funds Rate, Discount Rate, and Primary Credit Rate
Federal Funds Rate and Inflation Targets

Percent

4% 3% 2% 1% 0% Target Inflation Rates

Actual


Calculated federal funds rate is based on Taylor's rule. See notes on page 19.

Components of Taylor's Rule

Actual and Potential Real GDP
Billions of chain-weighted 2000 dollars

Actual
Potential


PCE Inflation
Percent change from year ago

Monetary Base Growth* and Inflation Targets
Percent

Target Inflation Rates 0% 1% 2% 3% 4%

Actual


Components of McCallum's Rule

Monetary Base Velocity Growth
Percent

1-Year Moving Average

4-Year Moving Average


Real Output Growth
Percent

1-Year Moving Average

10-Year Moving Average


*Modified for the effects of sweeps programs on reserve demand. Calculated base growth is based on McCallum's rule. Actual base growth is percent change from year ago. See notes on page 19.
Monetary Trends

Updated through 01/18/05

Implied One-Year Forward Rates
Percent

Rates on 3-Month Eurodollar Futures
Percent, daily data

Rates on Selected Federal Funds Futures Contracts
Percent, daily data

Rates on Federal Funds Futures on Selected Dates
Percent

Inflation-Indexed Treasury Securities
Percent, weekly data

Inflation-Indexed Treasury Yield Spreads
Percent, weekly data

Inflation-Indexed 10-Year Government Notes
Percent, weekly data

Inflation-Indexed 10-Year Government Yield Spreads
Percent, weekly data

Research Division
Federal Reserve Bank of St. Louis
### Monetary Trends

**Velocity**
Nominal GDP/MZM, Nominal GDP/M2 (Ratio Scale)

- **MZM**
  - 1974Q1 to 1993Q4
  - 1994Q1 to present

- **M2**
  - 1974Q1 to 1993Q4
  - 1994Q1 to present

**Interest Rates**
Percent

- **3-Month T-Bill**
- **MZM Own**
- **M2 Own**

### MZM Velocity and Interest Rate Spread
Ratio Scale

- **Interest Rate Spread** = 3-Month T-Bill less MZM Own Rate

### M2 Velocity and Interest Rate Spread
Ratio Scale

- **Interest Rate Spread** = 3-Month T-Bill less M2 Own Rate
Monetary Trends

Gross Domestic Product
Percent change from year ago

Real Gross Domestic Product
Percent change from year ago

Gross Domestic Product Price Index
Percent change from year ago

M2
Percent change from year ago

Dashed lines indicate 10-year moving averages.
Recent Inflation and Long-Term Interest Rates

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<th>2004Q3</th>
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Inflation and Long-Term Interest Rate Differentials

For more detailed information and analysis, please refer to the full report.
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*All values are given in billions of dollars.*
## Federal Funds Discount Rate

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<th>3-mo Yields</th>
<th>3-yr Yields</th>
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## Federal Reserve Bank of St. Louis

*All values are given as a percent at an annual rate.*
## Monetary Trends

### Percent change at an annual rate

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Definitions

M1: The sum of currency held outside the vaults of depository institutions, Federal Reserve Banks, and the U.S. Treasury; travelers checks; and demand and other checkable deposits issued by financial institutions (except demand deposits due to the Treasury and depository institutions), minus cash items in process of collection and Federal Reserve float.

MZM (money, zero maturity): M2 minus small-denomination time deposits, plus institutional money market mutual funds (that is, those included in M3 but excluded from M2). The label MZM was coined by William Poole (1991); the aggregate itself was proposed earlier by Motley (1988).

M2: M1 plus savings deposits (including money market deposit accounts) and small-denomination (under $100,000) time deposits issued by financial institutions; and shares in retail money market mutual funds (funds with initial investments under $50,000), net of retirement accounts.

M3: M2 plus large-denomination ($100,000 or more) time deposits; repurchase agreements issued by depository institutions; Eurodollars deposits, specifically, dollar-denominated deposits due to nonbank U.S. addresses held at foreign offices of U.S. banks worldwide and all banking offices in Canada and the United Kingdom; and institutional money market mutual funds (funds with initial investments of $50,000 or more).

Bank Credit: All loans, leases, and securities held by commercial banks.

Domestic Nonfinancial Debt: Total credit market liabilities of the U.S. Treasury, federally sponsored agencies, state and local governments, households, and nonfinancial firms. End-of-period basis.

Adjusted Monetary Base: The sum of currency in circulation outside Federal Reserve Banks and the U.S. Treasury, deposits of depository financial institutions at Federal Reserve Banks, and an adjustment for the effects of changes in statutory reserve requirements on the quantity of base money held by depositories. This series is a spliced chain index; see Anderson and Rasche (1996a,b, 2001, 2003).

Adjusted Reserves: The sum of vault cash and Federal Reserve Bank deposits held by depository institutions and an adjustment for the effects of changes in statutory reserve requirements on the quantity of base money held by depositories. This spliced chain index is numerically larger than the Board of Governors’ measure, which excludes vault cash not used to satisfy statutory reserve requirements and Federal Reserve Bank deposits used to satisfy required clearing balance contracts; see Anderson and Rasche (1996a, 2001, 2003).

Monetary Services Index: An index that measures the flow of monetary services received by households and firms from their holdings of liquid assets; see Anderson, Jones, and Nesmith (1997). Indexes are shown for the assets included in M2, with additional data at research.stlouisfed.org/mis/index.html.

Note: M1, M2, M3, Bank Credit, and Domestic Nonfinancial Debt are constructed and published by the Board of Governors of the Federal Reserve System. For details, see Statistical Supplement to the Federal Reserve Bulletin, tables 1.21 and 1.26. MZM, Adjusted Monetary Base, Adjusted Reserves, and Monetary Services Index are constructed and published by the Research Division of the Federal Reserve Bank of St. Louis.

Notes

Page 3: Readers are cautioned that, since early 1994, the level and growth of M1 have been depressed by retail sweep programs that reclassify transactions deposits (demand deposits and other checkable deposits) as savings deposits overnight, thereby reducing banks’ required reserves; see Anderson and Rasche (2001) and research.stlouisfed.org/aggreg/swdata.html. Primary Credit Rate, Discount Rate, and Intended Federal Funds Rate shown in the chart Reserve Market Rates are plotted as of the date of the change, while the Effective Federal Funds Rate is plotted as of the end of the month. Interest rates in the table are monthly averages from the Board of Governors H.15 Statistical Release. The Treasury Yield Curve shows constant maturity yields calculated by the U.S. Treasury for securities with 3 months and 1, 2, 3, 5, 7, and 10 years to maturity. Daily data and descriptions are available at research.stlouisfed.org/fred2/. See also Statistical Supplement to the Federal Reserve Bulletin, table 1.35. The 30-year constant maturity series was discontinued by the Treasury as of February 18, 2002.

Page 5: Checkable Deposits is the sum of demand and other checkable deposits. Savings Deposits is the sum of money market deposit accounts and passbook and statement savings. Time Deposits have a minimum initial maturity of 7 days. Large Time Deposits are deposits of $100,000 or more. Retail and Institutional Money Market Mutual Funds are as included in M2 and the non-M2 component of M3, respectively.

Page 7: Excess Reserves plus RCB (Required Clearing Balance) Contracts equals the amount of deposits at Federal Reserve Banks held by depository institutions but not applied to satisfy statutory reserve requirements. (This measure excludes the vault cash held by depository institutions that is not applied to satisfy statutory reserve requirements.) Consumer Credit includes most short- and intermediate-term credit extended to individuals. See Statistical Supplement to the Federal Reserve Bulletin, table 1.55.

Page 8: Inflation Expectations measures include the quarterly Federal Reserve Bank of Philadelphia Survey of Professional Forecasters, the monthly University of Michigan Survey Research Center’s Surveys of Consumers, and the annual Federal Open Market Committee (FOMC) range as reported to the Congress in the February testimony that accompanies the Monetary Policy Report to the Congress. Beginning February 2000, the FOMC began using the personal consumption expenditures (PCE) price index to report its inflation range; the FOMC then switched to the PCE chain-type price index excluding food and energy prices (“core”) beginning July 2004. Accordingly, neither are shown on this graph. CPI Inflation is the percentage change from a year ago in the consumer price index for all urban consumers. Real Interest Rates are ex post measures, equal to nominal rates minus CPI inflation.

Page 9: FOMC Intended Federal Funds Rate is the level (or midpoint of the range, if applicable) of the federal funds rate that the staff of the FOMC expected to be consistent with the desired degree of pressure on bank reserve positions. In recent years, the FOMC has set an explicit target for the federal funds rate.

Page 10: Federal Funds Rate and Inflation Targets shows the observed federal funds rate, quarterly, and the level of the funds rate implied by applying Taylor’s (1993) equation $\Delta f_t = 2.5 + \pi_{t-1} + \pi_{t-1} - \pi_{t}/2 + 100 \times (y_{t-1} - y_{t-1})/2$ to five alternative target inflation rates, $\pi_t = 0, 1, 2, 3, 4$ percent, where $f_t$ is the implied federal funds rate, $\pi_{t-1}$ is the previous period’s inflation rate (PCE) measured on a year-over-year basis, $y_{t-1}$ is the log of the previous period’s level of real gross domestic product (GDP), and $y_{t-1} - \pi_{t-1}$ is the log of an estimate of the previous period’s level of potential output. Potential Real GDP is as estimated by the Congressional Budget Office.

Monetary Base Growth and Inflation Targets shows the quarterly growth of the adjusted monetary base (modified to include an estimate of the effect of sweep programs) implied by applying McCallum’s (1988, 1993) equation $\Delta MB_t = \pi_t + (10$-year moving average growth of real GDP) $- (4$-year moving average of base velocity growth) to five alternative target inflation rates, $\pi_t = 0, 1, 2, 3, 4$ percent, where $\Delta MB_t$ is the implied growth rate of the adjusted monetary base. The 10-year moving average growth of real GDP for a quarter $t$ is calculated as the average quarterly growth during the previous 40 quarters, at an annual rate, by the formula $(\gamma_t - \gamma_{t-40})/400 \times 100$, where $\gamma_t$ is the log of real GDP. The 4-year moving average of base velocity growth is calculated similarly. To adjust the monetary base for the effect of retail-deposit sweep programs, we add to the monetary base an amount equal to 10 percent of the total amount swept, as estimated by the Federal Reserve Board staff. These estimates are imprecise, at best. Sweep program data are found at research.stlouisfed.org/aggreg/swdata.html.

Page 11: Implied One-Year Forward Rates are calculated by this Bank from Treasury constant maturity yields. Yields to maturity, $R(m)$, for securities with $m = 1,\ldots, 10$ years to maturity are obtained by linear interpolation between
Monetary Trends

reported yields. These yields are smoothed by fitting the regression suggested by Nelson and Siegel (1987),
\[ R(m) = a_0 + (a_1 + a_2)(1 - e^{-m/50})(m/50) - a_3 e^{-m/50}, \]
and forward rates are calculated from these smoothed yields using equation (a) in table 13.1 of Shiller (1990),
\[ f(m) = [D(m)R(m) - D(m-1)] /[ D(m) - D(m-1)], \]
where duration is approximated as \( D(m) = (1 - e^{-R(m) \times m})/R(m) \). These rates are linear approximations to the true instantaneous forward rates; see Shiller (1990). For a discussion of the use of forward rates as indicators of inflation expectations, see Sharpe (1997). Rates on 3-Month Eurodollar Futures and Rates on Selected Federal Funds Futures Contracts trace through time the yield on three specific contracts. Rates on Federal Funds Futures on Selected Dates displays a single day’s snapshot of yields for contracts expiring in the months shown on the horizontal axis. Inflation-Indexed Treasury Securities are yields on the most recently issued inflation-indexed securities of 10- and 30-year original maturities. Inflation-Indexed 10-Year Government Notes shows the yield of an inflation-indexed note that is scheduled to mature in approximately (but not greater than) 10 years. The current French note has a maturity date of 7/25/2013, the current U.K. note has a maturity date of 8/16/2013, and the current U.S. note has a maturity date of 7/15/2014. Inflation-Indexed Treasury Yield Spreads and Inflation-Indexed 10-Year Government Yield Spreads equal the difference between the yields on the most recently issued inflation-indexed securities and the unadjusted security yields of similar maturity.

Page 12: Velocity (for MZM and M2) equals the ratio of GDP, measured in current dollars, to the level of the monetary aggregate. MZM and M2 Own Rates are weighted averages of the rates received by households and firms on the assets included in the aggregates. Prior to 1982, the 3-month T-bill rates are secondary market yields. From 1982 forward, rates are 3-month constant maturity yields.

Page 13: Real Gross Domestic Product is GDP as measured in chained 2000 dollars. The Gross Domestic Product Price Index is the implicit price deflator for GDP, which is defined by the Bureau of Economic Analysis, U.S. Department of Commerce, as the ratio of GDP measured in current dollars to GDP measured in chained 2000 dollars.

Page 14: Investment Securities are all securities held by commercial banks in both investment and trading accounts.

Page 15: Inflation Rate Differentials are the differences between the foreign consumer price inflation rates and year-over-year changes in the U.S. all-items Consumer Price Index.

Page 17: Treasury Yields are Treasury constant maturities as reported in the Board of Governors of the Federal Reserve System’s H.15 release.

Sources

Agence France Trésor: French note yields.
Bank of Canada: Canadian note yields.
Board of Governors of the Federal Reserve System:
Bureau of Economic Analysis: GDP.
Bureau of Labor Statistics: CPI.
Chicago Board of Trade: Federal funds futures contract.
Chicago Mercantile Exchange: Eurodollar futures.
Congressional Budget Office: Potential real GDP.

Federal Reserve Bank of St. Louis: Adjusted monetary base and adjusted reserves, monetary services index, MZM own rate, one-year forward rates.
Organization for Economic Cooperation and Development: International interest and inflation rates.
Standard & Poor’s: Stock price-earnings ratio, stock price composite index.
University of Michigan Survey Research Center: Median expected price change.

References


Note: *Available on the Internet at research.stlouisfed.org/publications/review/.