reported yields. These yields are smoothed by fitting the regression suggested by Nelson and Siegel (1987),
\[
\begin{align*}
\ln(v(t)) &= \alpha_0 + \alpha_1 t + \alpha_2 (1 - e^{-t/\beta}) + \epsilon(t),
\end{align*}
\]
and forward rates are calculated from these smoothed yields using equation (a) in table 3.1 of Shiller (1990).
\[
\text{(a) } f(t) = \frac{D(0,t)}{D(0,1)} - \frac{D(0,1)}{D(t)},
\]
where duration is approximate as
\[
\text{(b) } d(t) = \frac{1}{r(t)} \left( \frac{D(t)}{D(0,1)} - 1 \right).
\]
These ratios are linear approximations to the true term structure forward rates as specified by Shiller (1990). For a discussion of the use of forward rates as indicators of inflation expectations, see Sharp (1997). Raw Federal Reserve Bank of St. Louis Eurodollar Futures and Rates on Selected Federal Funds Futures Contracts trace through the yield on the three specific contracts. Rates on Federal Funds Futures on Selected Dates display a supply of yields for contract expiration 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 9/25/2015, and the current U.S. note has a maturity date of 1/30/2015. Inflation-indexed Treasury Securities 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 weights averaged of the rates of return of bank 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 in 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 difference between the consumer price inflation rate and rate of year-over-year changes in the U.S. all items Consumer Price Index.

Page 17: Treasury Yields are current maturity rates as reported in the Board of Governors of the Federal Reserve System’s H15 release.

**Sources**


**References**


**Monetary Trends**


Federal Reserve Bank of St. Louis: Adjusted monetary base and adjusted reserves, monetary services index. MZM own rate, one-year forward rate.

Organization for Economic Cooperation and Development: International interest and inflation rates.


**Wicksell’s Natural Rate**

Most central banks now implement monetary policy by setting a near-term target for an overnight interbank interest rate, in turn, policymakers face the difficult issue of how to choose, and adjust, the target rate. One widely discussed policy guide is the "natural," or equilibrium, real rate of interest. To use this guide, one compares the yield of a medium-term financial-market real interest rate—such as the yield on a 10-year Treasury inflation-indexed bond—to an estimate of the long-term "natural," or equilibrium, rate of return on the economy’s capital stock. The idea that inflation will be approximately constant when these two rates of return are equal is an extension of an idea advanced in 1898 by the Swedish economist Knuts Wicksell.

Wicksell, throughout his career, was an unwavering advocate of the quantity theory of money. He argued that increases in the economy’s average level of prices were due to increases in the monetary base, that is, increases beyond the increase in the economy’s overall output. Precisely how this occurred, he felt, was nuñbled in writings of the time. With the natural rate concept, he sought to illuminate the transmission mechanism behind the quantity theory and to begin connecting the monetary base, banks’ extension of credit, aggregate demand, and inflation.

Wicksell based his theory on a comparison of the marginal product of capital with the cost of borrowing money. If the money rate of interest was below the natural rate of return on capital, entrepreneurs would borrow at the money rate to purchase capital (equipment and buildings), thereby increasing demand for all types of resources and their prices; the product would be true if the money rate was greater than the natural rate of return on capital. (Wicksell did not distinguish real from nominal interest rates because, under the gold standard of the time, sustained inflation was unlikely. Hence, all interest rates and rates of return should be interpreted as real rates.) So long as the money rate of interest persisted below the natural rate of return on capital, upward price pressures would continue. In Wicksell’s theory, price pressure could arise even if new credit were extended only against increases in production, that is, against “real bills.” Price stability would result only when the money rate of interest and the natural rate of return on capital—the marginal product of capital—were equal.

Wicksell trained his theory of money, output and inflation. He did not propose a market mechanism that determined the money rate of interest. Nor did he advocate an activist policy based on the natural rate for Sweden’s central bank. In fact, his work did, however, inspire later writers. John Maynard Keynes took up Wicksell’s unfinished quest for a theory connecting the price level to money and credit in his 1930 A Treatise on Money.

Implementing monetary policy by means of a natural rate framework has many uncertainties. The most relevant financial market rates for household and firm behavior likely are not the overnight rates set by central banks, but rather are intermediate rates of runs to 5 years to maturity. Shocks to the economy, such as an energy or financial crisis, may cause near-term real rates of return on capital to deviate significantly from the longer-term rate of return on capital. Further, the natural rate is not observable. It varies with the economy’s underlying ability to produce, and must be estimated from empirical models often subject to substantial disagreement. Beyond differences in structure, models depend on assumed long-run projections for variables such as productivity growth, the share of national income received by capital, the aggregate savings rate from GDP, the growth of the labor force, the rate of depreciation of capital, and the variances and covariances of shocks to the economy. Agreement among economists on these issues does not seem imminent.

Ironically, Wicksell’s work laid the foundations that have led economists during the twentieth century to shift away from analysis of the quantity theory of money and, in some cases, to omit money entirely. Modern models based on the natural rate concept likely have some distance to go before they become useful guides to monetary policy.

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*Richard G. Anderson*

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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 in transit in process of collection and Federal Reserve float.

M2M (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 MS2M was coined by William Poole (1994); the aggregate itself was proposed earlier by Mosk (1988).

M3: 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 and 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 the adjustment for the effects of changes in statutory reserve requirements on the quantity of base money held by depositories. This series is a simple chain index; see Anderson and Rasken (1996, 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 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 Rasken (1996a, 2005, 2009).

Monetary Service 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 Neumling (1997). Indexes are shown for the assets included in M2, with additional data at research.stlouisfed.org/menulink.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 1.20. M3: Adjusted Monetary Base, Adjusted Reserves, and Monetary Service Index are constructed and published by the Research Division of the Federal Reserve Bank of St. Louis.

Notes

Page 9: Readers are cautioned that, since early 1994, the level and growth of M1 have been depressed by retail sweep programs that reflect transactions deposits (demand deposits and other checkable deposits as savings deposits overnight, thereby reducing ‘bank’ required reserve; see Anderson and Rasken (2003) and research.stlouisfed.org/aggregates.html). Primary Credit Rate, Discount Rate, and Adjusted Federal Funds Rate shown in the chart Reserve Market Rates are plotted as of the date of the chart, while the Effective Federal Funds Rate is plotted as of the end of the month. Interest rates in the table are monthly averages of 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 and data availability are described at research.stlouisfed.org/fs/2222. See also Statistical Supplement to the Federal Reserve Bulletin, table 1.35. The 50-year constant maturity series was discontinued by the Treasury as of February 13, 2002.

Page 10: Checkable Deposits is the sum of demand and other checkable deposits. Savings Deposits is the sum of money market deposit accounts and savings and time market 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-M1 and M2 components of the table, respectively. See Statistical Supplement to the Federal Reserve Bulletin, table 1.55.

Page 11: 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 accompanied 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 rate; the FOMC then switched to the PCE chained-stationary 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 in point estimates, equal to nominal rates minus CPI inflation.

Page 12: 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 expects 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.
<table>
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<th>Year</th>
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<th>Reserves</th>
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<td>2004</td>
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<tr>
<td>2004</td>
<td>318.394</td>
<td>31</td>
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*All values are given in billions of dollars.
Monetary Trends

M1
Percent change at an annual rate

M2
Percent change at an annual rate

M3
Percent change at an annual rate

M2M
Percent change at an annual rate

Monetary Trends

Standard & Poor’s 500

Recent Inflation and Long-Term Interest Rates

Inflation and Long-Term Interest Rate Differentials
**Monetary Trends**

**Inflation and Inflation Expectations**

Percent

- Federal Reserve Bank of Philadelphia
- Humphrey-Hawkins CPI Inflation Range
- University of Michigan
- 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.

**Gross Domestic Product**

Percent change from year ago

Dashed lines indicate 10-year moving averages.

**Real Gross Domestic Product**

Percent change from year ago

Dashed lines indicate 10-year moving averages.

**Gross Domestic Product Price Index**

Percent change from year ago

Dashed lines indicate 10-year moving averages.

**M2**

Percent change from year ago

Dashed lines indicate 10-year moving averages.

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8

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13