Greenspan’s Unconventional View of the Long-Run Inflation/Output Trade-off

Since becoming Chairman of the Federal Reserve in 1987, Alan Greenspan steadfastly has held to the view that low and stable inflation is a prerequisite for maximum sustainable economic growth. He has reiterated this belief many times during his nearly two decades as Fed Chairman. In congressional testimony in July 1988, he stated that “the strategy for monetary policy needs to be centered on making further progress toward and ultimately reaching stable prices,” which he defined as “a situation in which households and businesses in making their saving and investment decisions can safely ignore the possibility of sustained, generalized price increases or decreases.”1 In February 1989, Greenspan explicitly noted that the Fed’s ultimate objective is “maximum sustainable economic growth over time” and that “the primary role of monetary policy in the pursuit of this goal is to foster price stability.”2 Greenspan’s definition of price stability implies that economic growth is maximized with a stable price level (i.e., zero inflation). He made this explicit at the July 1996 FOMC meeting, when he responded to the question of what level of inflation no longer alters decisionmaking: “I would say the number is zero, if inflation is properly measured.”3 Hence, the Chairman suggests that a sustained inflation rate above zero, properly measured, will keep output growth below its maximum level. While never explicitly stated, the idea of a maximum and the inclusion of price decreases in his definition of price stability imply sustained deflation also has deleterious effects on output growth.

Greenspan’s view of a long-run negative relationship between inflation and output growth is unconventional. Starting with the “Phillips curve,” economists came to believe that lower rates of inflation could be obtained only by reducing output. In the late 1960s Milton Friedman and Edmund Phelps demonstrated that, if economic agents are rational, the trade-off could not be maintained indefinitely—i.e., the steady-state level of output is independent of the rate of inflation, so that the long-run Phillips curve is vertical. Most economists believe that, beyond some rate, inflation does reduce output; however, many believe that the long-run relationship is vertical over a range of “moderate” inflation. If inflation has no permanent effect on the level of output, it cannot have a permanent effect on the growth rate of output. Hence, Greenspan’s view that sustainable output growth is maximized when inflation is zero is clearly unconventional.

Replacing the vertical Phillips curve with a negatively sloped one is not trivial for at least two reasons. First, there is no particular reason for policymakers to pursue zero inflation if the long-run relationship is vertical. Any low steady-state inflation rate will do as well. Consequently, policymakers might be inclined to accept some “moderate inflation,” if for no other reason than to appease those who believe that a little inflation is good for growth.

Second, because it is commonly believed that the steady-state inflation rate can be reduced only if the economy grows at a rate below potential for the period of disinflation, it is frequently suggested that, once inflation is established it is better to tolerate some “moderate” inflation than to bear the economic costs of reducing the inflation rate to zero. This argument is significantly weakened, if not eliminated, if inflation causes the economy to grow below its maximum rate.4

The Greenspan principle—maximum sustainable economic growth is achieved at zero inflation—is not yet reflected in modern monetary policy analyses. Nearly all theoretical analyses incorporate some variant of an “expectations-augmented Phillips curve,” where inflation is influenced by the gap between actual and potential output in the short-run. Most of these models assume the economy’s long-run growth rate is driven by exogenous factors (e.g., technology and the growth rate of the labor force) that are independent of monetary policy. Therefore, the Greenspan principle is not reflected in conventional models. Given Greenspan’s success over the past two decades, it would seem desirable that models be modified to allow for the unconventional Greenspan principle. One possibility is to incorporate Greenspan’s observation that “as the inflation rate falls, it becomes increasingly difficult for producers to raise prices. They therefore tend to try to reduce costs in order to maintain margins.”5

—Robert H. Rasche and Daniel L. Thornton

1 Testimony before the Committee on Banking, Finance and Urban Affairs, U.S. Senate, July 13, 1988.
2 Testimony before the Committee on Banking, Finance and Urban Affairs, U.S. Senate, February 21, 1989.
3 Transcript of the FOMC meeting held on July 2-3, 1996, p. 51.
5 Transcript of the FOMC meeting held on July 2-3, 1996, p. 46.
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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: \( \left( \frac{x_t}{x_{t-12}} - 1 \right) \times 100 \).

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On March 23, 2006, the Board of Governors of the Federal Reserve System will cease the publication of the M3 monetary aggregate. It will also cease publishing the following components: large-denomination time deposits, RPs, and eurodollars.
M1
Percent change at an annual rate

*Actual values for September and October 2001 are 55.87 and -38.35 percent rate, respectively.

MZM
Percent change at an annual rate

*Actual value for September 2001 is 39.41 percent rate.

M2
Percent change at an annual rate

*Actual value for September 2001 is 24.90 percent rate.

M3
Percent change at an annual rate
Inflation and Inflation Expectations

Yield to maturity

-2 -4 -6 -8

Treasury Security Yield Spreads

-2 -4 -6 -8

Real Interest Rates

Percent, Real rate = Nominal rate less CPI inflation

-2 -4 -6 -8
Monetary Trends

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

PCE Inflation
Percent change from year ago

Components of McCallum's Rule

Monetary Base Growth* and Inflation Targets
Percent

*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 Base Velocity Growth
Percent

Real Output Growth
Percent

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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.
Monetary Trends

Bank Credit
Percent change from year ago

Investment Securities in Bank Credit at Commercial Banks
Percent change from year ago

Total Loans and Leases in Bank Credit at Commercial Banks
Percent change from year ago

Commercial and Industrial Loans at Commercial Banks
Percent change from year ago

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Federal Reserve Bank of St. Louis
Recent Inflation and Long-Term Interest Rates

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<th>Consumer Price Inflation Rates</th>
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Inflation and Long-Term Interest Rate Differentials

-6 -3 0 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48
2002 2003 2004 2005

-6 -3 0 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48
2002 2003 2004 2005

Inflation differential = Foreign inflation less U.S. inflation
Long-term rate differential = Foreign rate less U.S. rate
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*All values are given in billions of dollars.
## Monetary Trends

Updated through 12/07/05

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*All values are given as a percent at an annual rate.*
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<td>1.80</td>
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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.

M3 (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 M3 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 ($100,000 or more) 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; Eurodollar 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 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 and services received by households and firms from their holdings of liquid assets; see Anderson, Jones, and Nesmith (1997). Indexes are shown for the assets owned by the public sector except for currency, and for deposits held by depository institutions, those owned by the public sector except for currency, and for deposits held by depository institutions, those owned by the public sector except for currency.

Primary Credit Rate: The primary credit rate on the Federal Reserve’s discount window, which serves as a measure of the discount rate charged for loans by the Federal Reserve Banks to depository institutions.

Discount Rate: The discount rate charged by the Federal Reserve Banks to depository institutions for loans on Treasury securities, repurchase agreements, and other collateral.

Intended Federal Funds Rate: The interest rate that the staff of the Federal Open Market Committee (FOMC) intended to set as the short-term interest rate target.

Intended 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

\[ f_t^r = 2.5 + \pi_{t-1} + (\pi_{t-1} - \pi_t)/2 + 100 \times (\pi_t - y_{t-1}^f)/2 \]

to five alternative target inflation rates, \( \pi_t^* = 0, 1, 2, 3, 4 \) percent, where \( f_t^r \) is the implied federal funds rate. \( \pi_{t-1} \) is the previous period’s inflation rate (PCE) measured on a year-over-year basis, \( y_{t-1}^f \) is the log of the previous period’s real gross domestic product (GDP), and \( y_t^f \) 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

\[ \Delta B_t = \pi_t^* + (10\text{-year moving average growth of real GDP}) - (4\text{-year moving average of base velocity growth}) \]

to five alternative target inflation rates, \( \pi_t^* = 0, 1, 2, 3, 4 \) percent, where \( \Delta B_t^* \) 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

\[ ((y_t - y_{t-40})/40) \times 400 \]

where \( y_t \) 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/aggres/swdata.html.

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/aggres/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 and Real Treasury Yield Curve show constant maturity yields calculated by the U.S. Treasury for securities 5, 7, 10, and 20 years to maturity. Inflation-Indexed Treasury Yield Spreads are a measure of inflation compensation at those horizons, and it is simply the nominal constant maturity yield less the real constant maturity yield. 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

\[ f_t^r = 2.5 + \pi_{t-1} + (\pi_{t-1} - \pi_t)/2 + 100 \times (\pi_t - y_{t-1}^f)/2 \]

to five alternative target inflation rates, \( \pi_t^* = 0, 1, 2, 3, 4 \) percent, where \( f_t^r \) is the implied federal funds rate. \( \pi_{t-1} \) is the previous period’s inflation rate (PCE) measured on a year-over-year basis, \( y_{t-1}^f \) is the log of the previous period’s real gross domestic product (GDP), and \( y_t^f \) 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 Trends**

*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 reported yields. These yields are smoothed by fitting the regression suggested by Nelson and Siegel (1987),

\[
R(m) = a_0 + (a_1 + a_2)(1 - e^{-m(50)/y(m/50)}) - a_3 e^{-m(50)/y(m/50)},
\]

and forward rates are calculated from these smoothed yields using equation (a) in table 13.1 of Shiller (1990),

\[
f(m) = \frac{[D(m)R(m) - D(m-1)]}{[D(m) - D(m-1)]},
\]

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 and Yield Spreads* are those plotted on page 3. *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 7/25/2015, the current U.K. note has a maturity date of 8/16/2013, and the current U.S. note has a maturity date of 7/15/2015. *Inflation-Indexed Treasury Yield Spreads* and *Inflation-Indexed 10-Year Government Yield Spreads* are calculated from these smoothed yields using equation (a) in table 13.1 of Shiller (1990),

\[
D(m) = \frac{[D(m)R(m) - D(m-1)]}{[D(m) - D(m-1)]},
\]

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 and Yield Spreads* are those plotted on page 3. *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 7/25/2015, the current U.K. note has a maturity date of 8/16/2013, and the current U.S. note has a maturity date of 7/15/2015. *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.

*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.

*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.

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

*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.

*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.

**References**


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