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.

[4] See Daniel L. Thornton, "The Costs and Benefits of Price Stability: An Assessment of Howitt's Rule," Federal Reserve Bank of St. Louis *Review*, March/April 1996, *78*(2), pp. 23-38.

[5] Transcript of the FOMC meeting held on July 2-3, 1996, p. 46.

Contents

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: $[(x_t/x_{t-1})-1]\times 1200$. 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: $[(x_t/x_{t-12})-1]\times 100$.
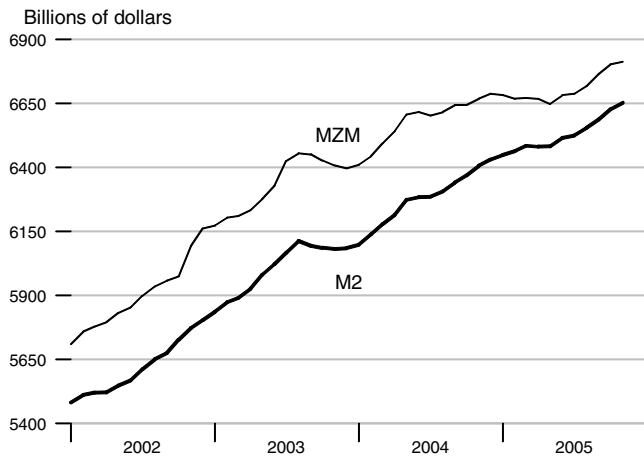
We welcome your comments addressed to:

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

or to:

stlsFRED@stls.frb.org

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.
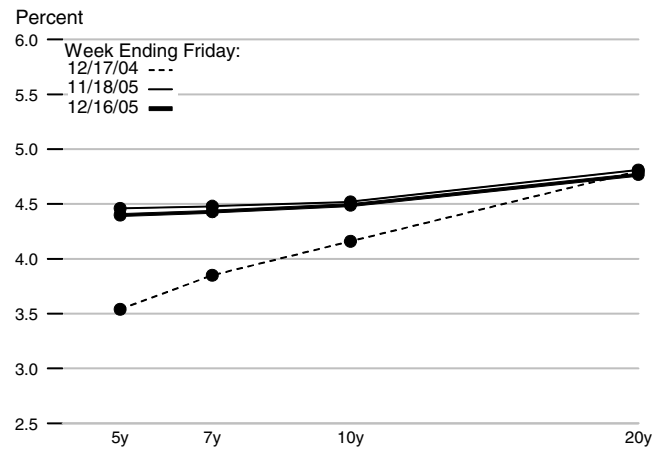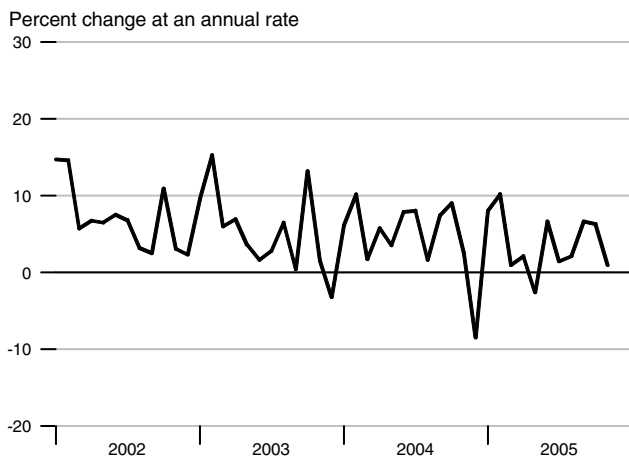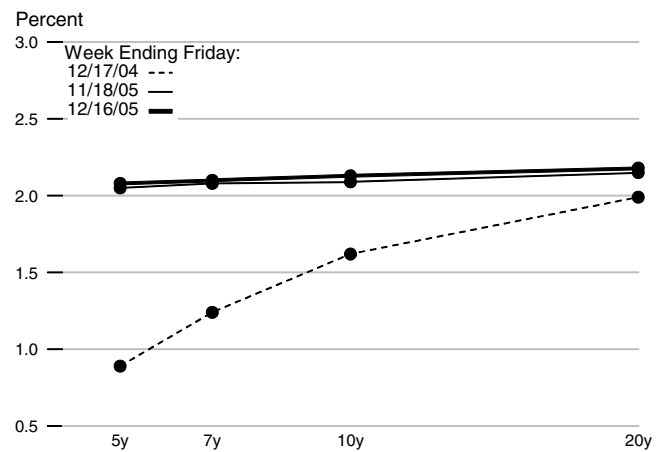
M2 and MZM

Billions of dollars

Treasury Yield Curve

Percent

Week Ending Friday:
12/17/04 ----
11/18/05 —
12/16/05 —

Adjusted Monetary Base

Percent change at an annual rate

Real Treasury Yield Curve

Percent

Week Ending Friday:
12/17/04 ----
11/18/05 —
12/16/05 —

Reserve Market Rates

Percent

---- Effective Federal Funds Rate
— Intended Federal Funds Rate

Primary Credit Rate

Discount Rate

Inflation-Indexed Treasury Yield Spreads

Percent

Week Ending Friday:
12/17/04 ----
11/18/05 —
12/16/05 —
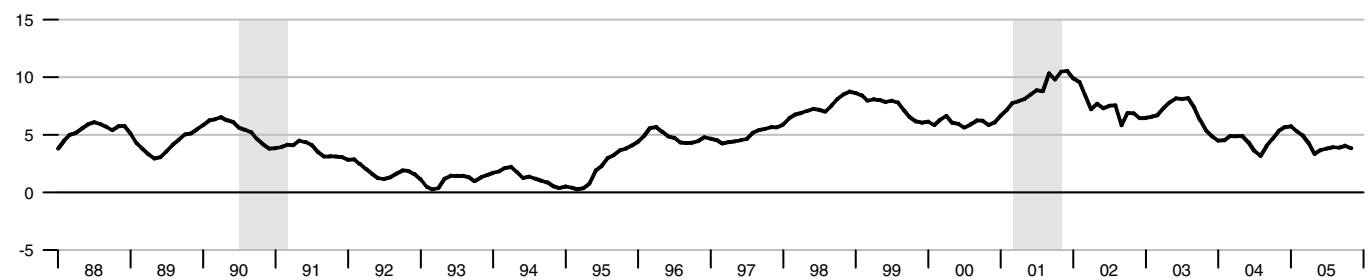
MZM and M1

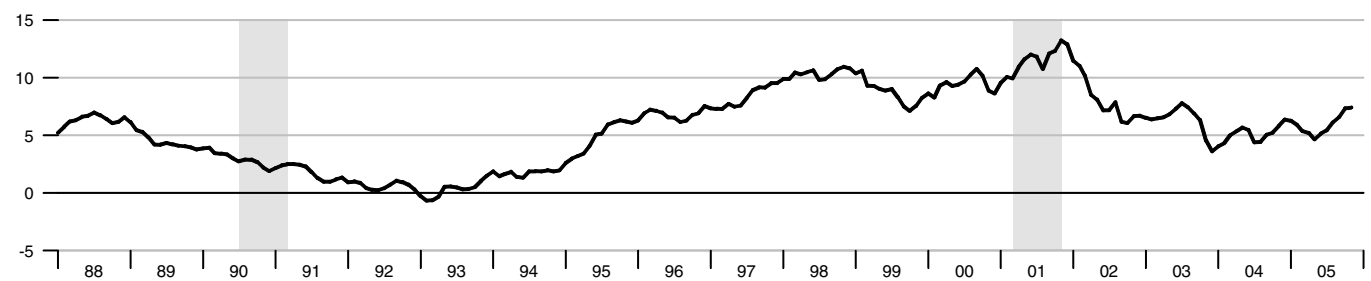Percent change from year ago

M2
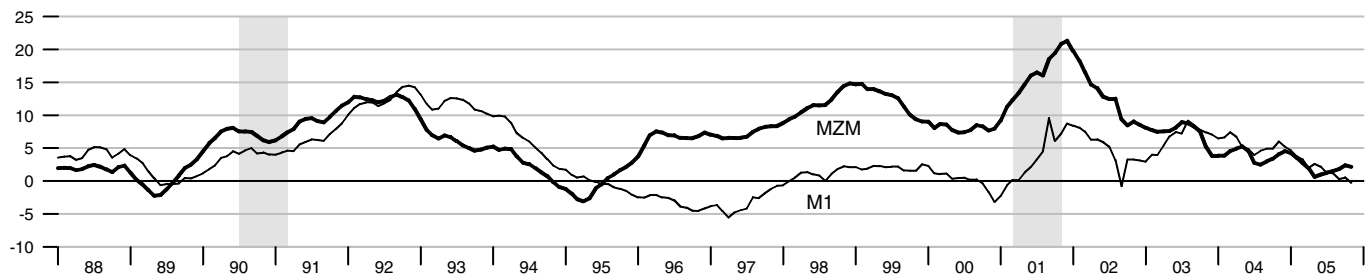
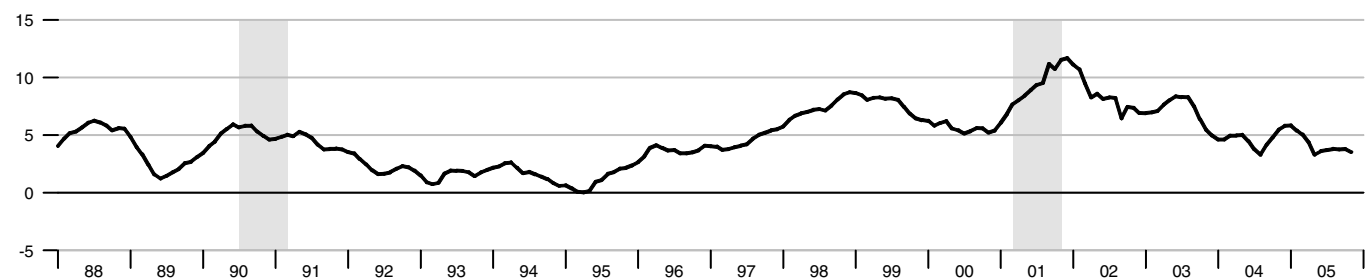Percent change from year ago

M3

Percent change from year ago

Monetary Services Index - M2

Percent change from year ago

Adjusted Monetary Base

Percent change from year ago
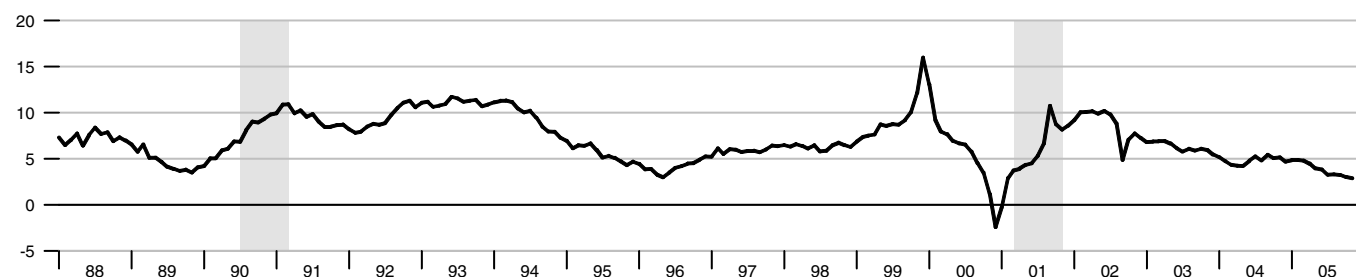
Domestic Nonfinancial Debt

Percent change from year ago
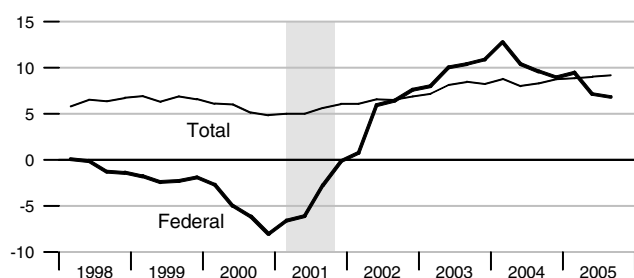
Currency Held by the Nonbank Public

Percent change from year ago
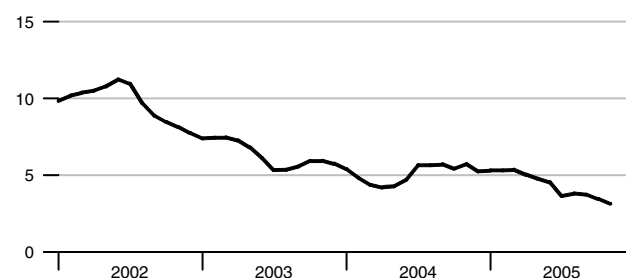
Time Deposits

Percent change from year ago
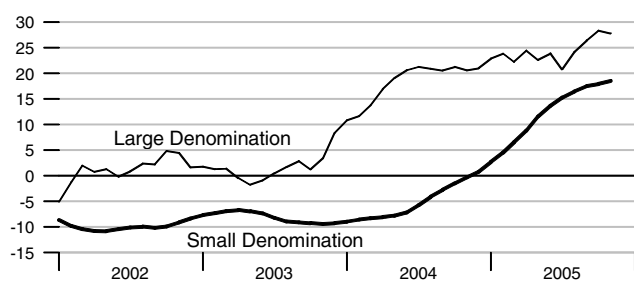
Checkable and Savings Deposits

Percent change from year ago
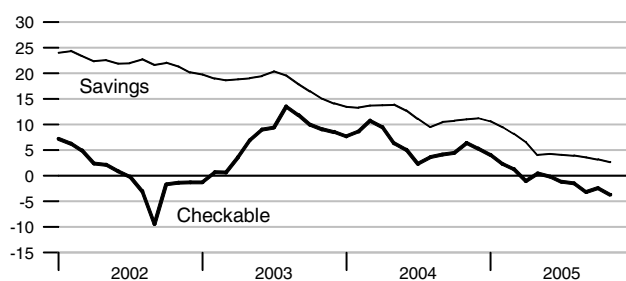
Money Market Mutual Fund Shares

Percent change from year ago
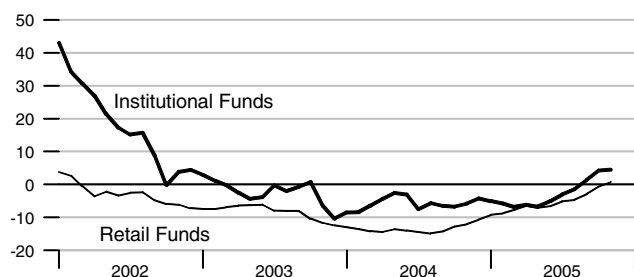
Repurchase Agreements and Eurodollars

Billions of dollars   Billions of dollars
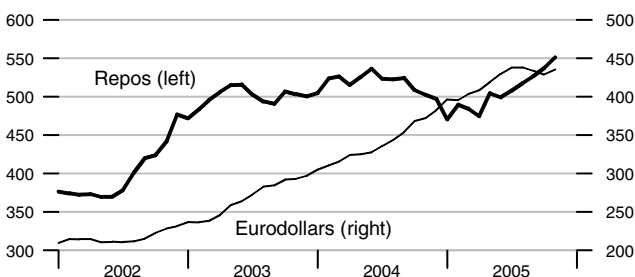
M1

Percent change at an annual rate
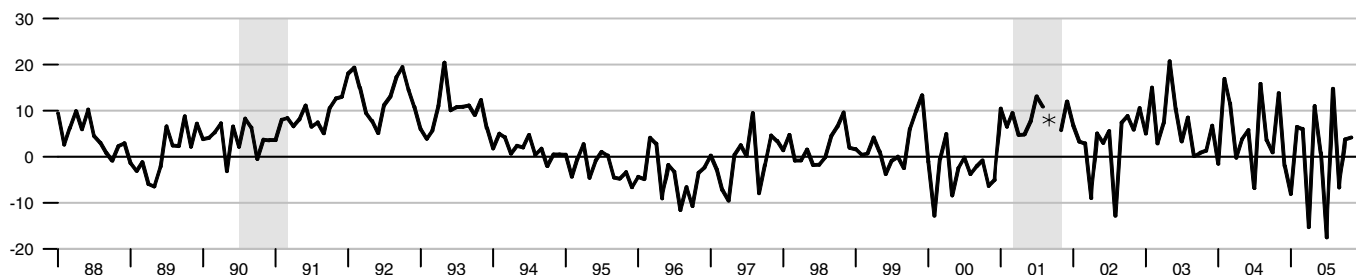
*Actual values for September and October 2001 are 55.87 and -38.35 percent rate, respectively.

MZM

Percent change at an annual rate
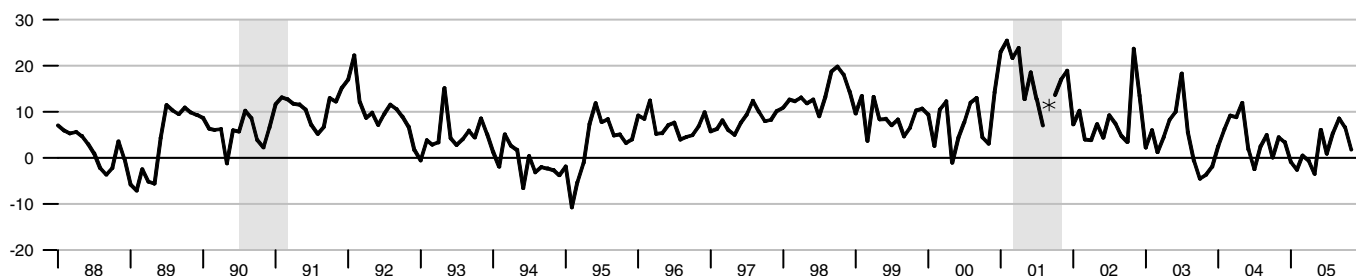
*Actual value for September 2001 is 39.41 percent rate.

M2

Percent change at an annual rate
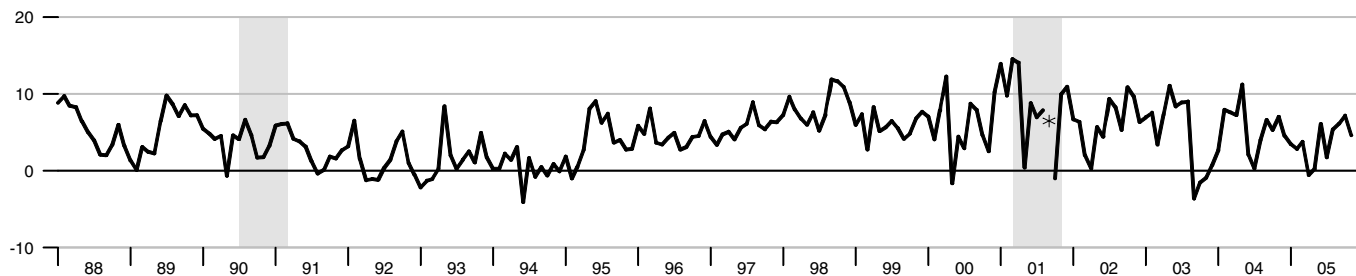
*Actual value for September 2001 is 24.90 percent rate.

M3

Percent change at an annual rate
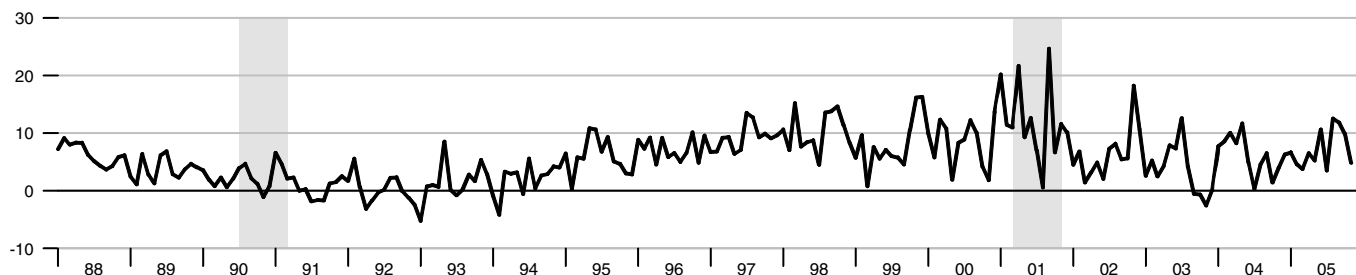
Adjusted and Required Reserves

Billions of dollars
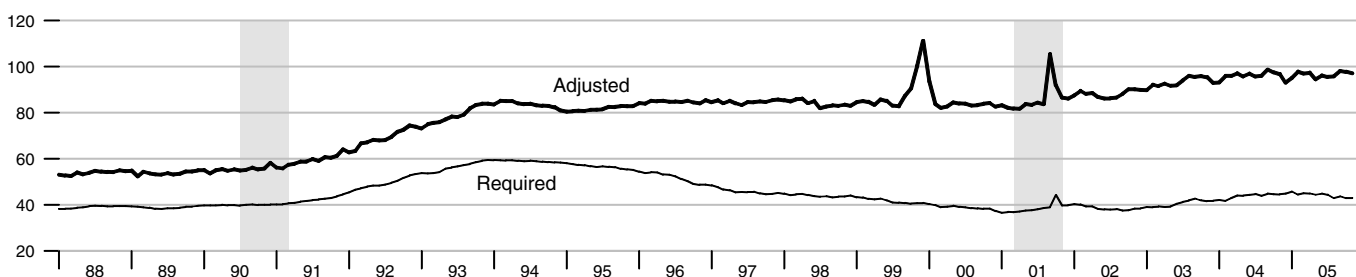
Total Borrowings, nsa

Billions of dollars
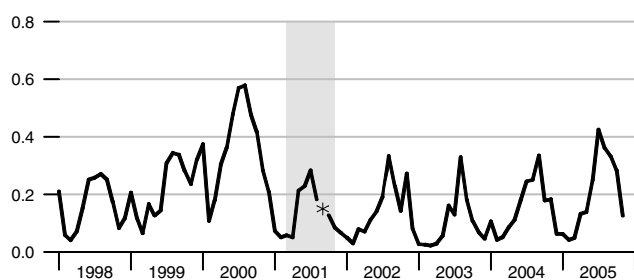
*Actual value for September 2001 is $3.4 billion.

Excess Reserves plus RCB Contracts

Billions of dollars
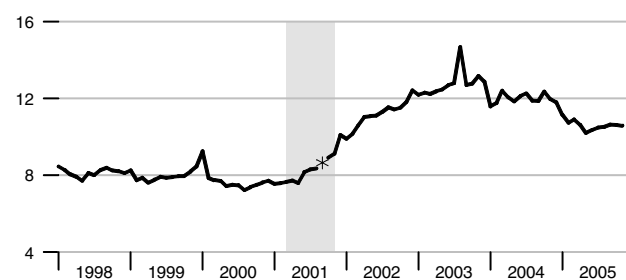
*Actual value for September 2001 is $26.43 billion.

Nonfinancial Commercial Paper

Percent change from year ago
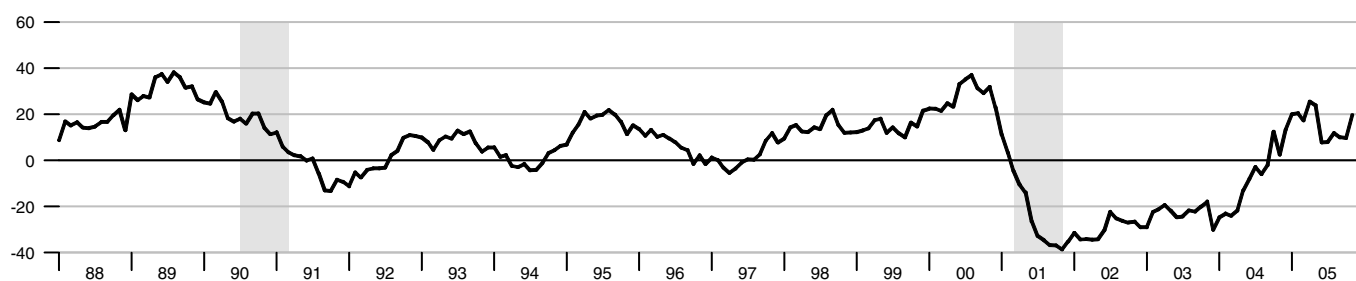
Consumer Credit

Percent change from year ago
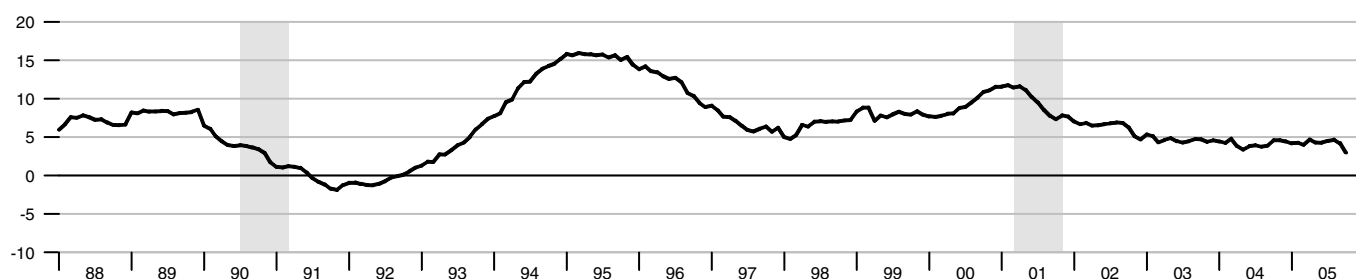
Inflation and Inflation Expectations

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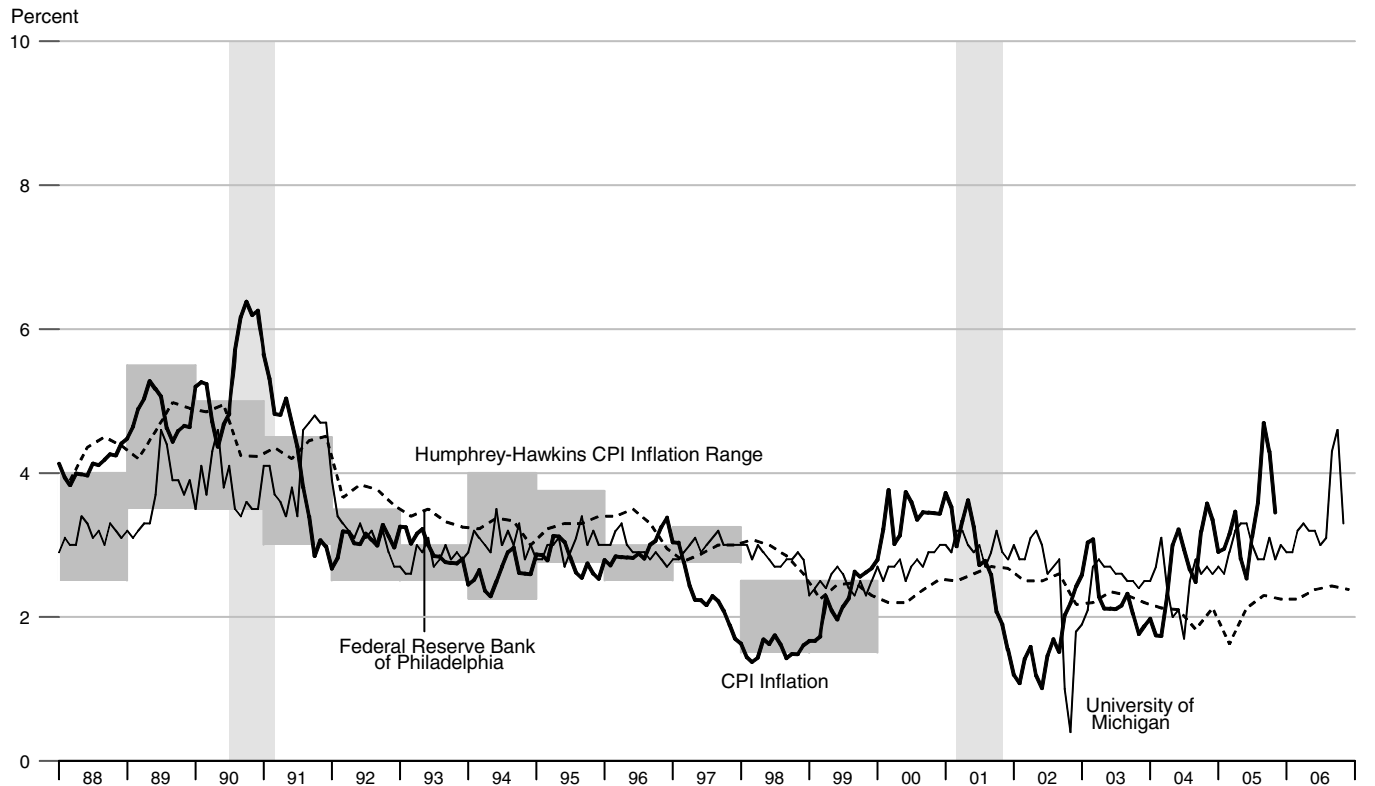
The shaded region shows the Humphrey-Hawkins CPI inflation range. Beginning in January 2000, the Humphrey-Hawkins inflation range was reported using the PCE price index and therefore is not shown on this graph. See notes on page 19.

Treasury Security Yield Spreads
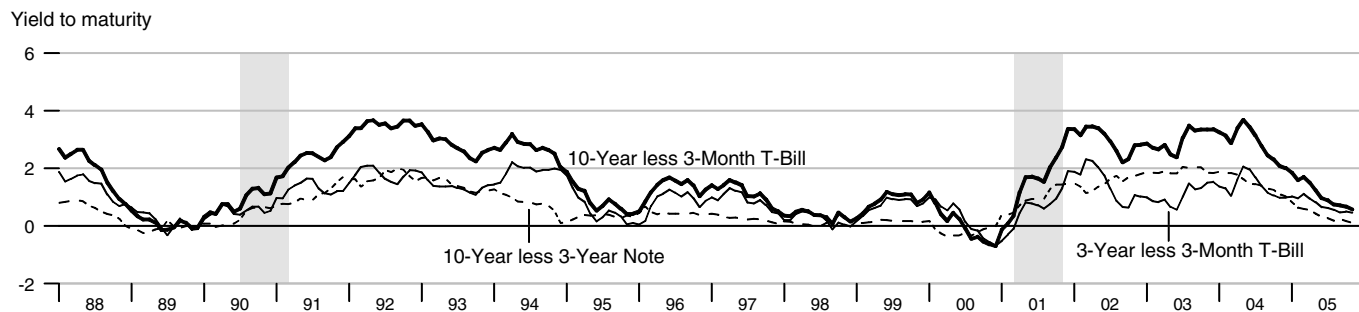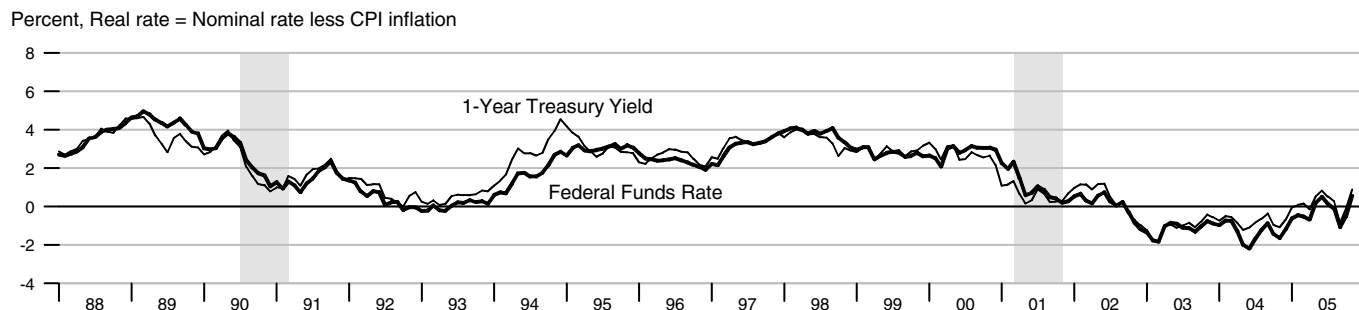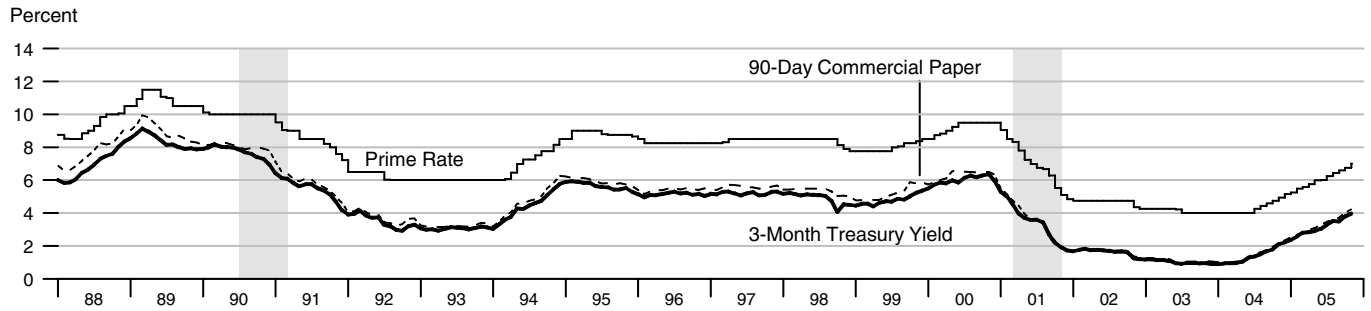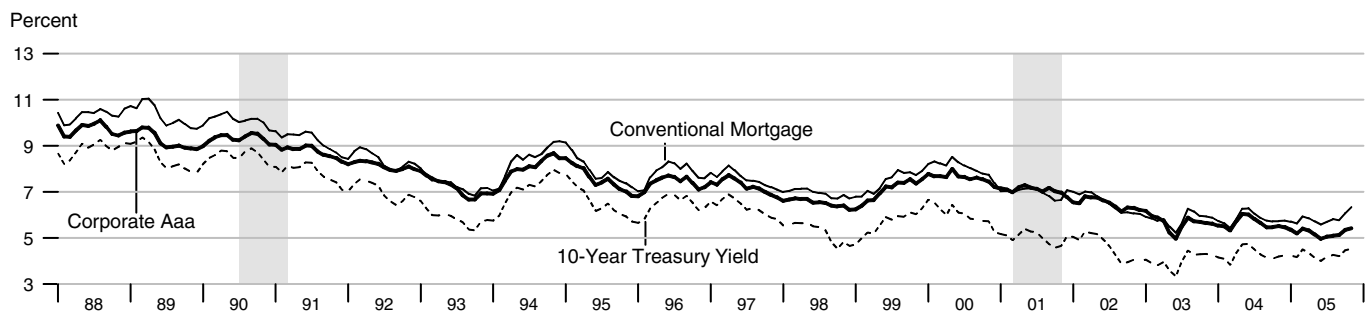
Yield to maturity

Real Interest Rates

Percent, Real rate = Nominal rate less CPI inflation

Short-Term Interest Rates

Percent

90-Day Commercial Paper
Prime Rate
3-Month Treasury Yield

Long-Term Interest Rates

Percent

Conventional Mortgage
Corporate Aaa
10-Year Treasury Yield

Long-Term Interest Rates

Percent

Corporate Baa
10-Year Treasury Yield

Short-Term Interest Rates

Percent

90-Day Commercial Paper
3-Month Treasury Yield
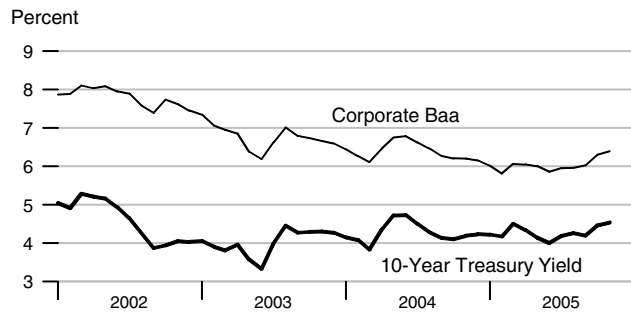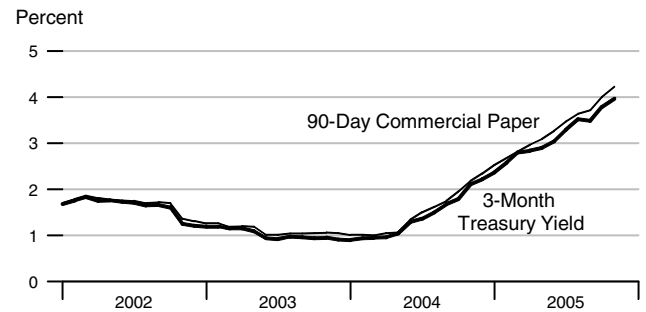
FOMC Intended Federal Funds Rate, Discount Rate, and Primary Credit Rate

Percent

Intended Federal Funds Rate
Discount Rate
Primary Credit Rate

Federal Funds Rate and Inflation Targets

Percent

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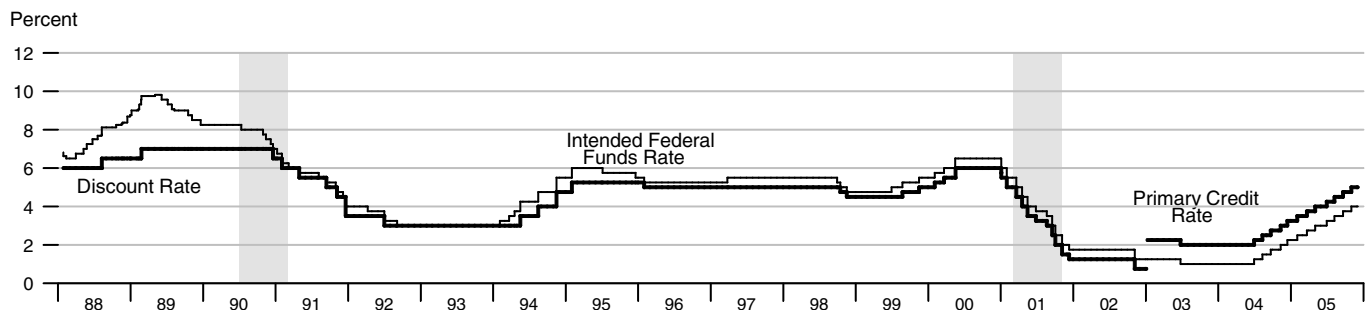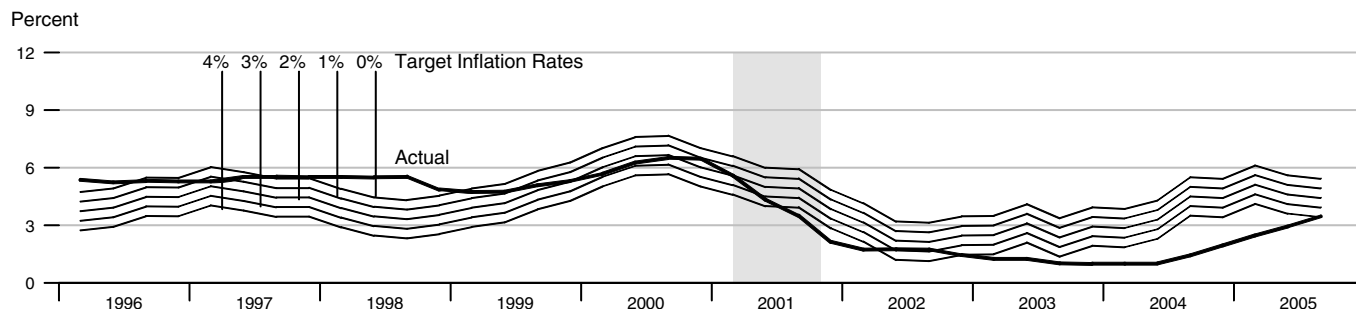
Actual

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

Potential

Actual

PCE Inflation

Percent change from year ago

Monetary Base Growth* and Inflation Targets

Percent

Actual

Target Inflation Rates   0% 1% 2% 3% 4%
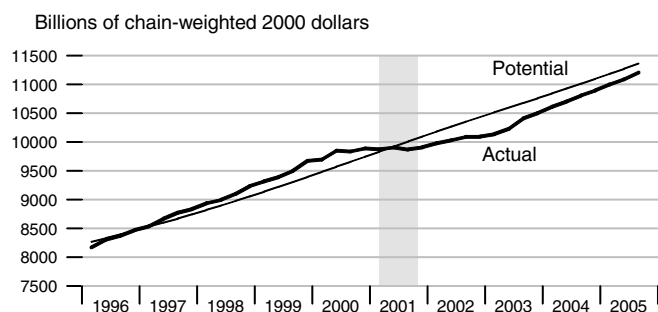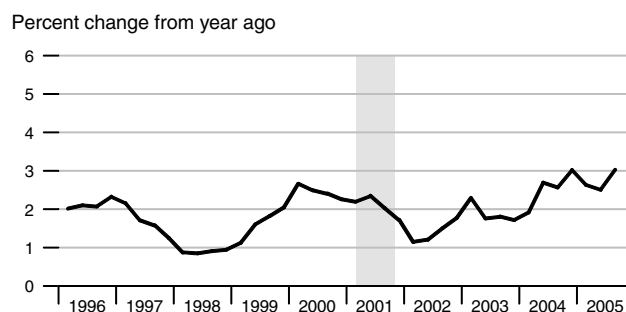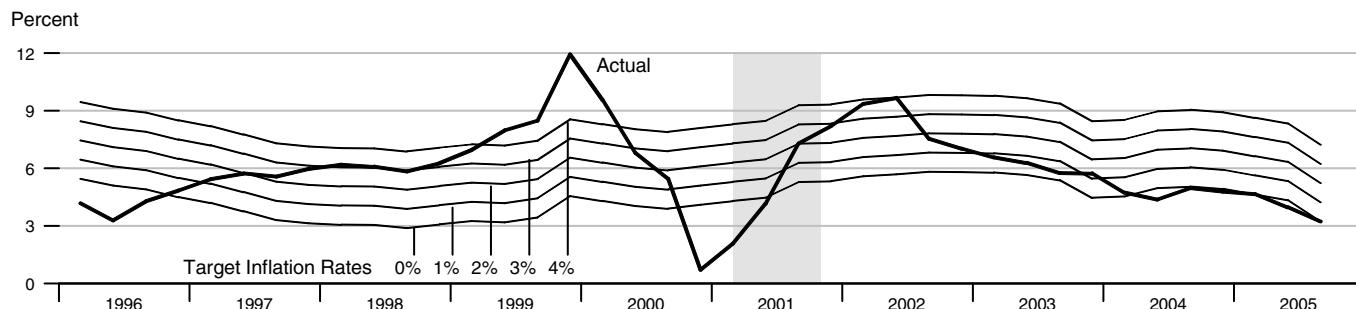
*Modified for the effects of sweeps programs on reserve demand.
Calculated base growth is based on McCallum's rule. Actual base growth is percent change from year ago. See notes on page 19.

Components of McCallum's Rule

Monetary Base Velocity Growth
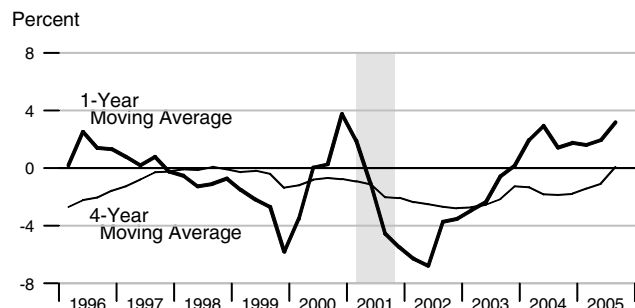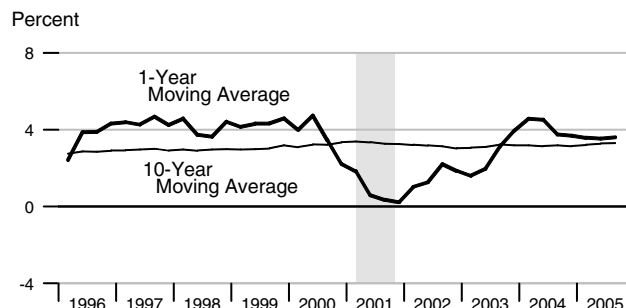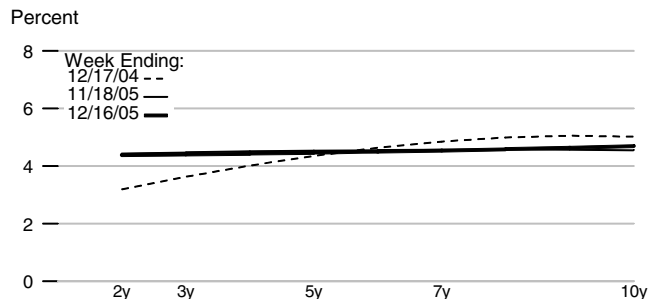
Percent

1-Year
Moving Average

4-Year
Moving Average

Real Output Growth

Percent

1-Year
Moving Average

10-Year
Moving Average

Implied One-Year Forward Rates

Percent

Week Ending:
12/17/04 - - -
11/18/05 ———
12/16/05 ━━━

Rates on 3-Month Eurodollar Futures

Percent, daily data

Feb 2006

Jan 2006

Dec 2005

Rates on Selected Federal Funds Futures Contracts

Percent, daily data

Feb 2006

Jan 2006

Dec 2005

Rates on Federal Funds Futures on Selected Dates

Percent

11/10/2005

12/16/2005

10/14/2005

Contract Month
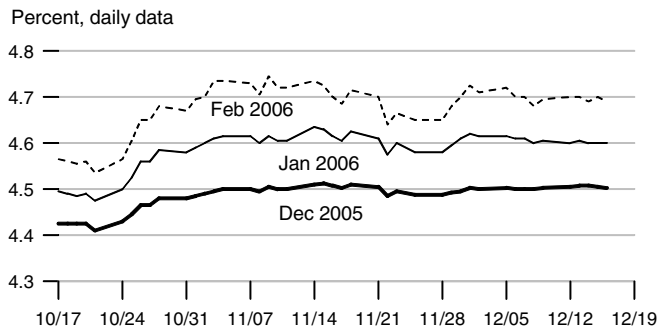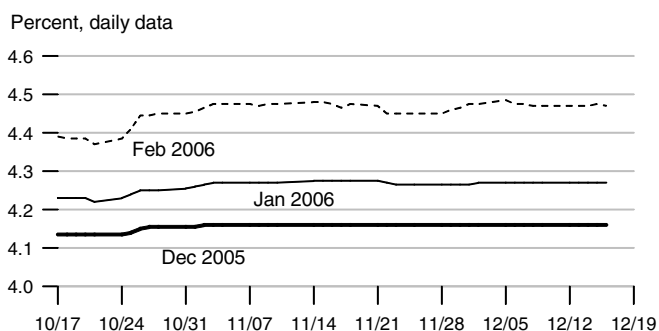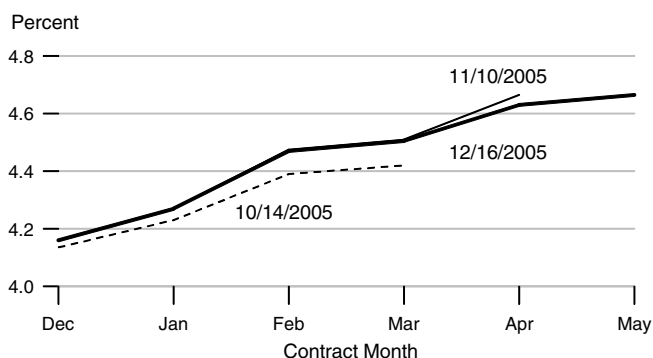
Inflation-Indexed Treasury Securities

Weekly data

Percent
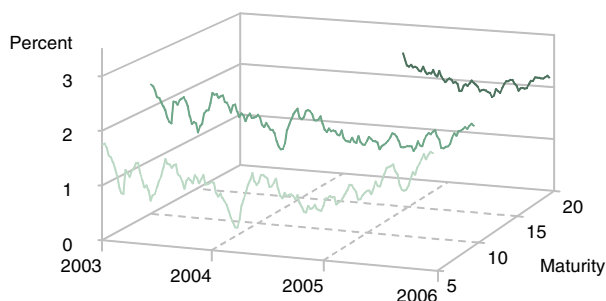
Maturity

Note: Yields are inflation-indexed constant maturity
U.S. Treasury securities

Inflation-Indexed Treasury Yield Spreads

Weekly data

Percent

Horizon
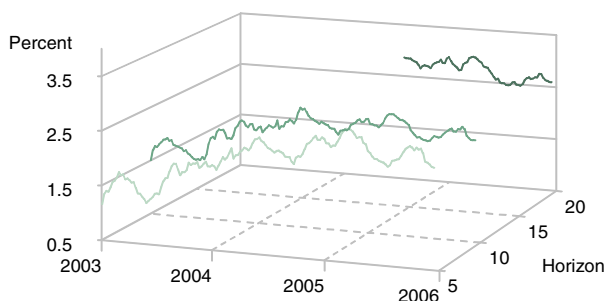
Note: Yield spread is between nominal and inflation-indexed
constant maturity U.S. Treasury securities.

Inflation-Indexed 10-Year Government Notes

Percent, weekly data

France

U.K.

U.S.
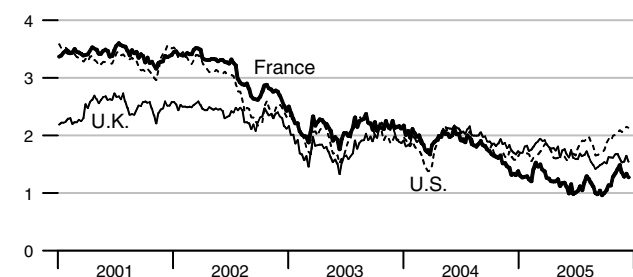
Inflation-Indexed 10-Year Government Yield Spreads

Percent, weekly data

U.K.

U.S.

France
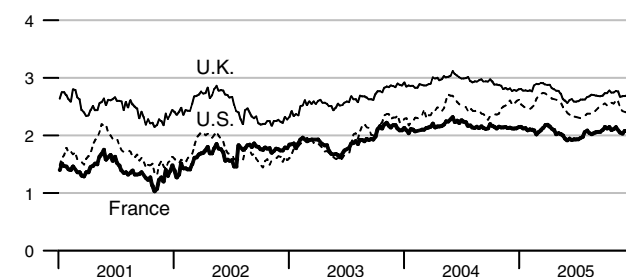
Velocity

Nominal GDP/MZM, Nominal GDP/M2 (Ratio Scale)
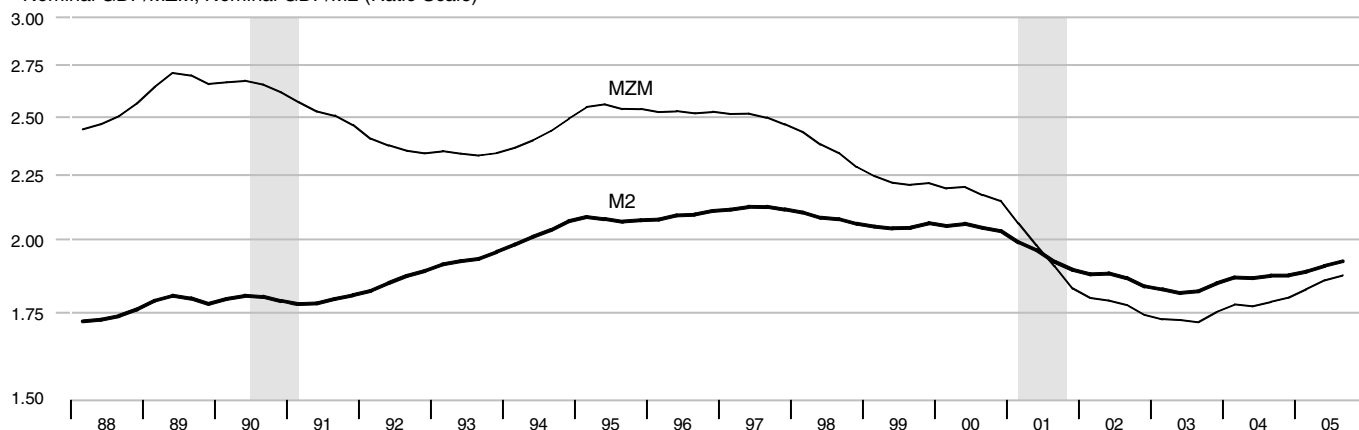
Interest Rates

Percent
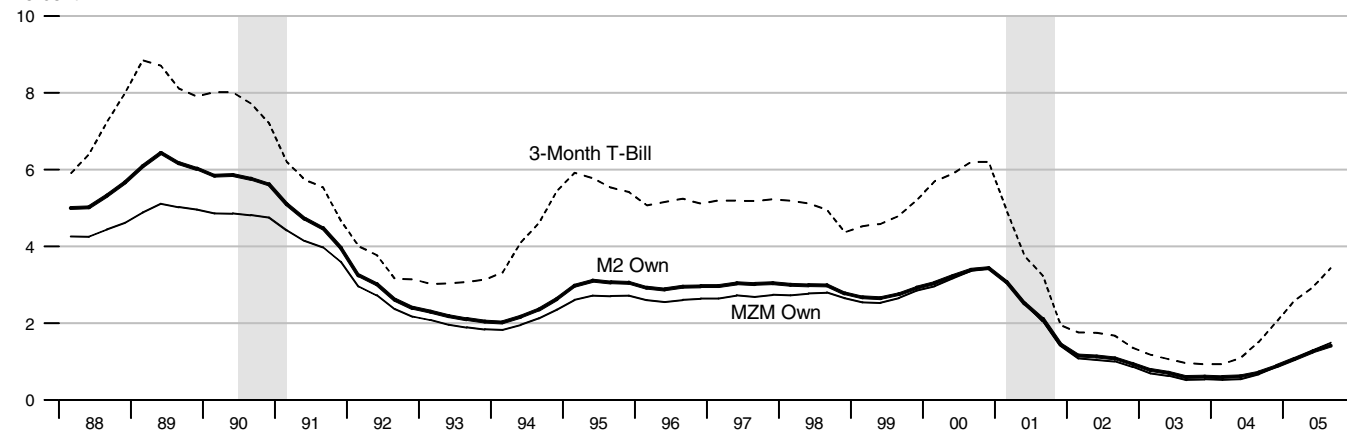
MZM Velocity and Interest Rate Spread
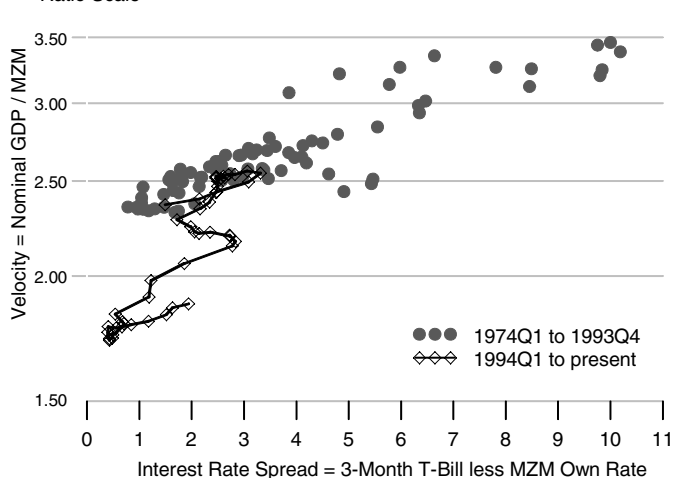
Ratio Scale

Velocity = Nominal GDP / MZM

●●● 1974Q1 to 1993Q4
◇◇◇ 1994Q1 to present

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

M2 Velocity and Interest Rate Spread

Ratio Scale

Velocity = Nominal GDP / M2

●●● 1974Q1 to 1993Q4
◇◇◇ 1994Q1 to present

Interest Rate Spread = 3-Month T-Bill less M2 Own Rate
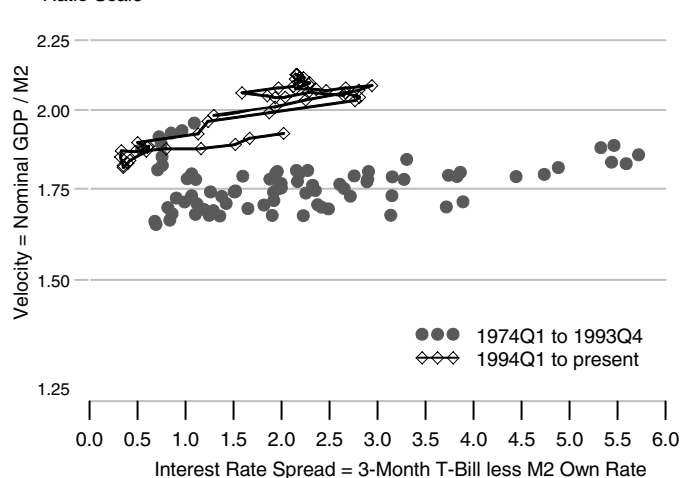
Gross Domestic Product

Percent change from year ago
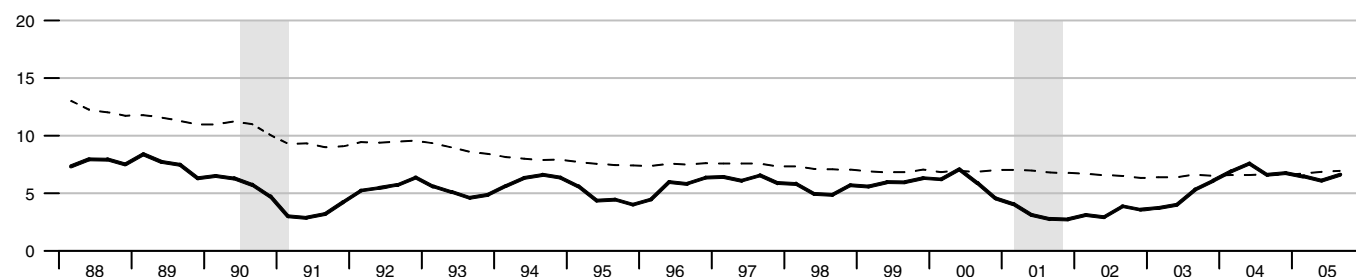
Dashed lines indicate 10-year moving averages.

Real Gross Domestic Product

Percent change from year ago
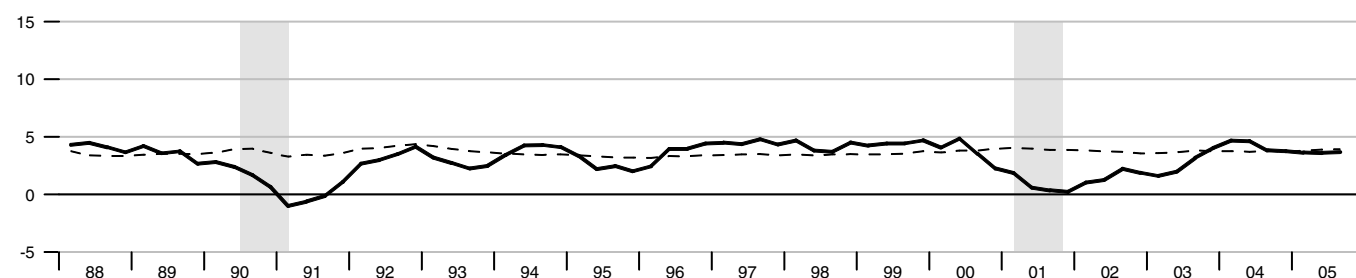
Dashed lines indicate 10-year moving averages.

Gross Domestic Product Price Index

Percent change from year ago
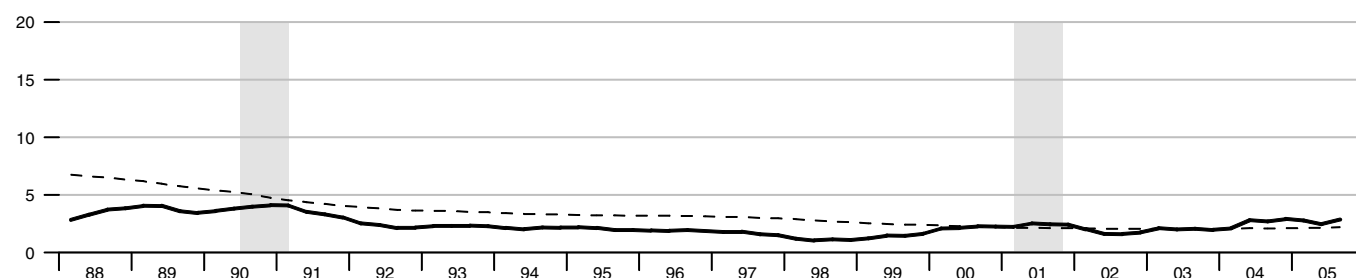
Dashed lines indicate 10-year moving averages.

M2

Percent change from year ago
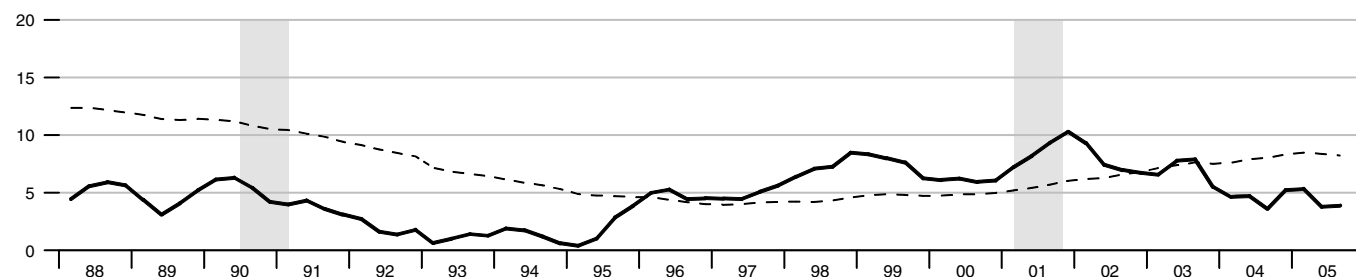
Dashed lines indicate 10-year moving averages.

Bank Credit

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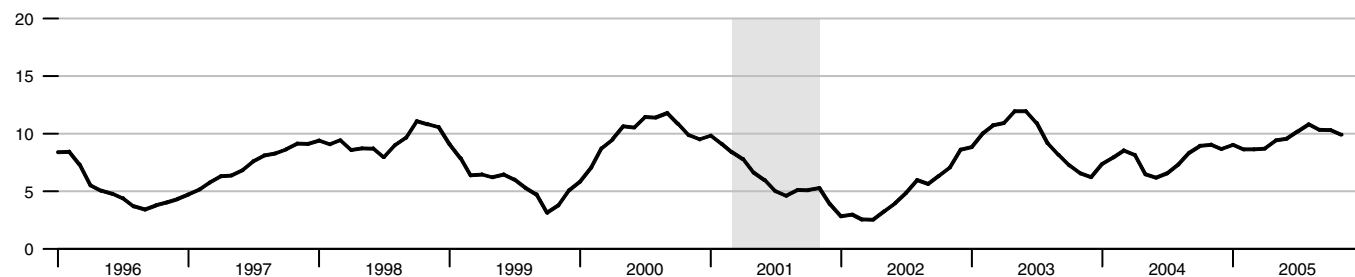
Investment Securities in Bank Credit at Commercial Banks

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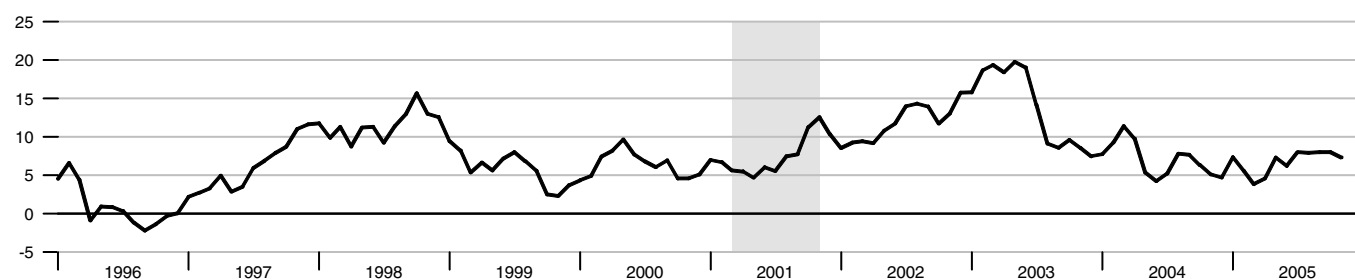
Total Loans and Leases in Bank Credit at Commercial Banks

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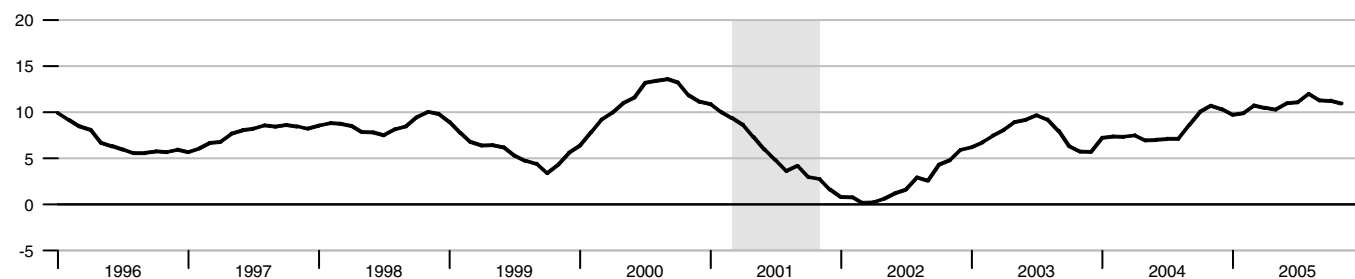
Commercial and Industrial Loans at Commercial Banks

Percent change from year ago
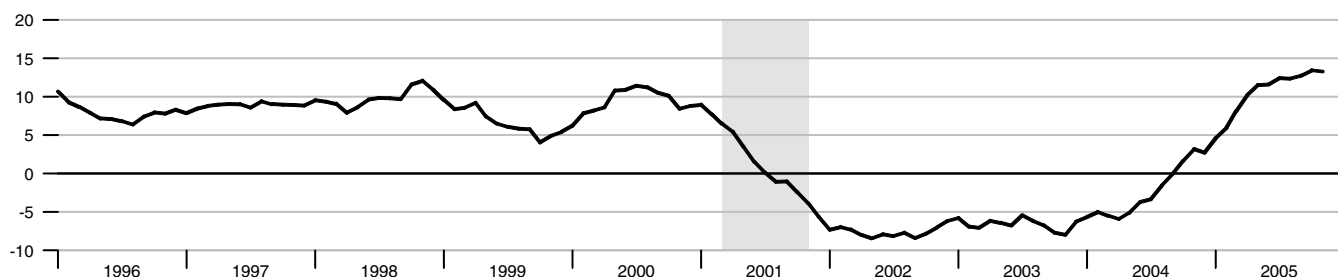
Standard & Poor's 500
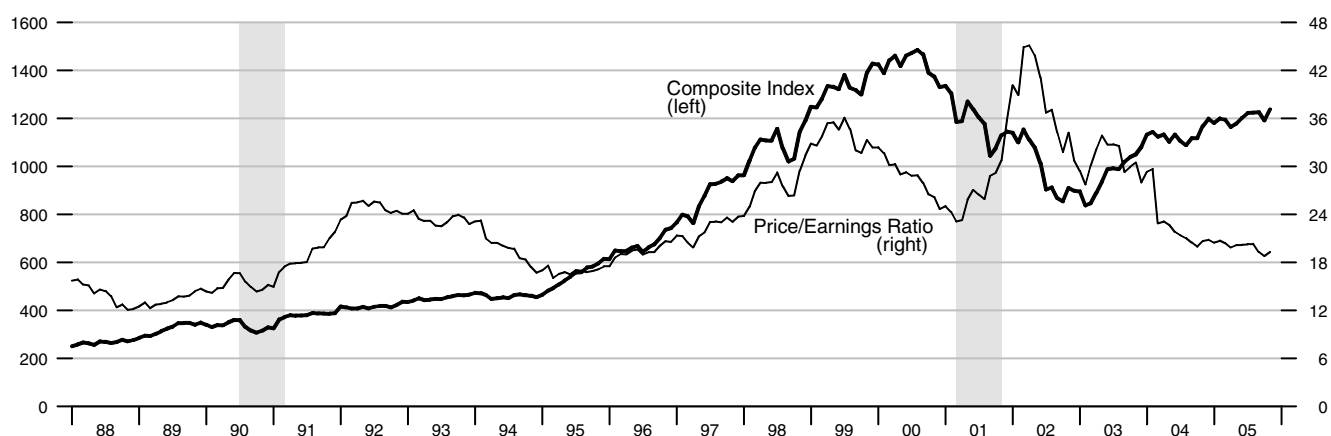
Recent Inflation and Long-Term Interest Rates

	Consumer Price Inflation Rates				Long-Term Government Bond Rates			
	Percent change from year ago				Percent			
	2004Q4	2005Q1	2005Q2	2005Q3	Aug05	Sep05	Oct05	Nov05
United States	3.37	3.00	2.93	3.80	4.26	4.20	4.46	4.54
Canada	2.29	2.13	1.90	2.64	3.92	3.87	4.06	4.10
France	2.08	1.70	1.69	1.90	3.30	3.13	3.29	.
Germany	1.98	1.74	1.70	2.13	3.23	3.07	3.24	3.45
Italy	1.98	1.92	1.84	2.03	3.45	3.29	3.44	3.66
Japan	0.48	-0.20	-0.14	-0.31	1.43	1.38	1.54	1.52
United Kingdom	3.41	3.17	3.01	2.78	4.31	4.24	4.37	.

Inflation and Long-Term Interest Rate Differentials

- - - - ——— Inflation differential = Foreign inflation less U.S. inflation
- - - - Long-term rate differential = Foreign rate less U.S. rate

Monetary Trends
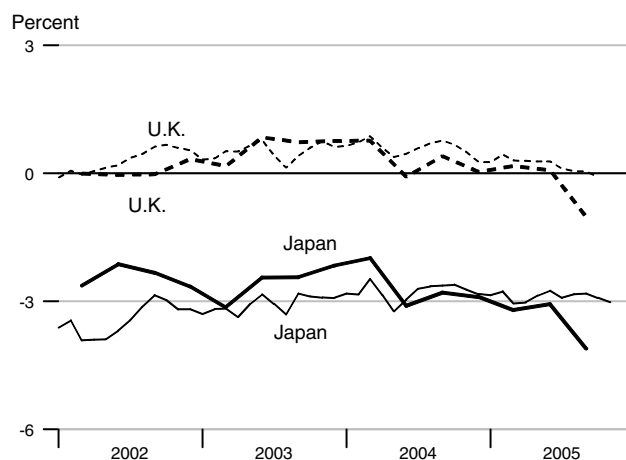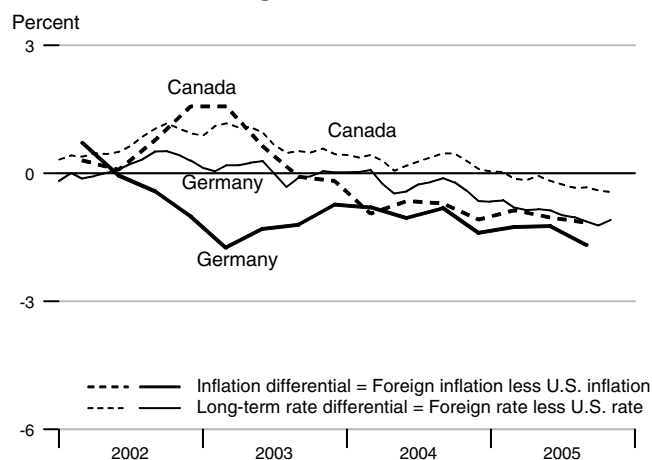
		Money Stock				Bank	Adjusted		
		M1	MZM	M2	M3	Credit	Monetary Base	Reserves	MSI M2
2000		1103.484	4507.601	4798.883	6860.005	5025.217	607.106	84.308	248.591
2001		1140.215	5223.438	5219.902	7646.741	5344.000	641.167	86.172	271.439
2002		1196.344	5895.446	5615.409	8261.403	5596.949	697.092	88.158	294.191
2003		1273.946	6332.382	6004.606	8788.514	6120.440	740.926	93.308	315.219
2004		1344.897	6581.409	6277.338	9236.793	6597.515	776.704	96.061	329.910
2003	1	1235.469	6195.709	5866.596	8624.845	5954.724	726.940	91.196	307.910
	2	1268.185	6279.599	5976.326	8735.938	6135.072	738.451	92.117	313.666
	3	1292.370	6443.859	6091.199	8901.791	6187.760	744.331	95.163	319.766
	4	1299.762	6410.361	6084.306	8891.481	6204.205	753.981	94.758	319.534
2004	1	1319.929	6449.505	6138.564	9010.315	6428.351	761.427	95.031	322.486
	2	1339.324	6587.990	6257.514	9216.103	6560.285	771.146	96.600	328.774
	3	1350.520	6621.038	6311.119	9313.488	6645.827	782.780	96.796	331.731
	4	1369.815	6667.102	6402.156	9407.267	6755.596	791.464	95.817	336.649
2005	1	1371.476	6674.403	6465.995	9536.920	6992.253	798.241	96.641	339.991
	2	1369.614	6666.311	6493.297	9677.226	7166.754	802.631	96.016	341.138
	3	1362.908	6723.367	6555.814	9877.239	7350.178	808.399	96.510	344.200
2003	Nov	1297.815	6407.337	6081.566	8884.999	6198.907	754.971	95.410	319.395
	Dec	1305.081	6396.868	6085.195	8885.301	6251.309	752.952	92.971	319.634
2004	Jan	1303.448	6410.822	6098.708	8942.455	6321.750	756.790	93.206	320.482
	Feb	1321.799	6444.242	6139.032	9006.604	6442.660	763.195	95.937	322.499
	Mar	1334.540	6493.452	6177.951	9081.885	6520.642	764.295	95.950	324.478
	Apr	1334.317	6541.332	6215.194	9144.307	6541.002	767.951	97.095	326.515
	May	1338.617	6606.287	6273.248	9233.171	6549.964	770.211	95.779	329.610
	Jun	1345.039	6616.350	6284.101	9270.830	6589.890	775.275	96.927	330.197
	Jul	1337.428	6602.798	6285.668	9273.163	6602.290	780.464	95.691	330.486
	Aug	1355.047	6616.533	6306.493	9308.479	6632.667	781.527	96.023	331.433
	Sep	1359.084	6643.783	6341.195	9358.822	6702.524	786.349	98.674	333.274
	Oct	1360.163	6644.202	6369.273	9369.946	6713.830	792.248	97.558	334.886
	Nov	1375.791	6669.000	6406.537	9401.368	6759.501	793.878	96.828	336.880
	Dec	1373.491	6688.104	6430.657	9450.486	6793.458	788.267	93.065	338.181
2005	Jan	1364.258	6683.116	6449.132	9502.881	6892.661	793.540	95.087	339.216
	Feb	1371.622	6668.727	6464.333	9538.993	6999.366	800.277	97.805	339.882
	Mar	1378.547	6671.365	6484.521	9568.887	7084.733	800.906	97.030	340.874
	Apr	1361.002	6667.923	6481.489	9620.719	7112.413	802.312	97.378	340.794
	May	1373.459	6648.663	6482.784	9662.775	7166.645	800.580	94.523	340.506
	Jun	1374.381	6682.348	6515.619	9748.184	7221.205	805.002	96.147	342.113
	Jul	1354.347	6687.394	6525.130	9776.759	7281.198	805.964	95.585	342.724
	Aug	1370.995	6717.466	6554.397	9878.755	7360.529	807.389	95.817	344.072
	Sep	1363.383	6765.242	6587.914	9976.202	7408.807	811.844	98.129	345.804
	Oct	1367.638	6802.688	6627.191	10058.13	7419.492	816.108	97.759	347.586
	Nov	1372.397	6812.903	6652.692	10098.65	7437.969	816.756	97.096	348.782

*All values are given in billions of dollars.

		Federal Funds	Primary Credit Rate	Prime Rate	3-mo CDs	Treasury Yields			Corporate Aaa Bonds	S & L Aaa Bonds	Conventional Mortgage
						3-mo	3-yr	10-yr			
	2000	6.24		9.23	6.46	6.00	6.22	6.03	7.62	5.58	8.06
	2001	3.89		6.92	3.69	3.47	4.08	5.02	7.08	5.01	6.97
	2002	1.67		4.68	1.73	1.63	3.10	4.61	6.49	4.87	6.54
	2003	1.13	2.11	4.12	1.15	1.03	2.11	4.02	5.67	4.52	5.82
	2004	1.35	2.34	4.34	1.56	1.40	2.78	4.27	5.63	4.50	5.84
2003	1	1.25	2.25	4.25	1.26	1.18	2.07	3.92	6.00	4.60	5.83
	2	1.25	2.23	4.24	1.17	1.06	1.77	3.62	5.31	4.28	5.51
	3	1.02	2.00	4.00	1.07	0.95	2.20	4.23	5.70	4.68	6.01
	4	1.00	2.00	4.00	1.10	0.93	2.38	4.29	5.66	4.52	5.92
2004	1	1.00	2.00	4.00	1.05	0.93	2.17	4.02	5.45	4.26	5.61
	2	1.01	2.00	4.00	1.25	1.10	2.98	4.60	5.93	4.82	6.13
	3	1.43	2.42	4.42	1.70	1.51	2.92	4.30	5.64	4.54	5.89
	4	1.95	2.94	4.94	2.25	2.04	3.05	4.17	5.48	4.39	5.73
2005	1	2.47	3.44	5.44	2.78	2.58	3.61	4.30	5.32	4.23	5.76
	2	2.94	3.91	5.91	3.23	2.93	3.73	4.16	5.15	4.15	5.72
	3	3.46	4.43	6.43	3.74	3.43	3.98	4.21	5.09	4.28	5.76
2003 Nov		1.00	2.00	4.00	1.11	0.95	2.45	4.30	5.65	4.50	5.93
Dec		0.98	2.00	4.00	1.10	0.91	2.44	4.27	5.62	4.41	5.88
2004 Jan		1.00	2.00	4.00	1.06	0.90	2.27	4.15	5.54	4.42	5.74
Feb		1.01	2.00	4.00	1.05	0.94	2.25	4.08	5.50	4.26	5.64
Mar		1.00	2.00	4.00	1.05	0.95	2.00	3.83	5.33	4.11	5.45
Apr		1.00	2.00	4.00	1.08	0.96	2.57	4.35	5.73	4.69	5.83
May		1.00	2.00	4.00	1.20	1.04	3.10	4.72	6.04	4.93	6.27
Jun		1.03	2.01	4.01	1.46	1.29	3.26	4.73	6.01	4.85	6.29
Jul		1.26	2.25	4.25	1.57	1.36	3.05	4.50	5.82	4.71	6.06
Aug		1.43	2.43	4.43	1.68	1.50	2.88	4.28	5.65	4.52	5.87
Sep		1.61	2.58	4.58	1.86	1.68	2.83	4.13	5.46	4.40	5.75
Oct		1.76	2.75	4.75	2.04	1.79	2.85	4.10	5.47	4.38	5.72
Nov		1.93	2.93	4.93	2.26	2.11	3.09	4.19	5.52	4.45	5.73
Dec		2.16	3.15	5.15	2.45	2.22	3.21	4.23	5.47	4.35	5.75
2005 Jan		2.28	3.25	5.25	2.61	2.37	3.39	4.22	5.36	4.24	5.71
Feb		2.50	3.49	5.49	2.77	2.58	3.54	4.17	5.20	4.16	5.63
Mar		2.63	3.58	5.58	2.97	2.80	3.91	4.50	5.40	4.29	5.93
Apr		2.79	3.75	5.75	3.09	2.84	3.79	4.34	5.33	4.18	5.86
May		3.00	3.98	5.98	3.22	2.90	3.72	4.14	5.15	4.20	5.72
Jun		3.04	4.01	6.01	3.38	3.04	3.69	4.00	4.96	4.08	5.58
Jul		3.26	4.25	6.25	3.57	3.29	3.91	4.18	5.06	4.18	5.70
Aug		3.50	4.44	6.44	3.77	3.52	4.08	4.26	5.09	4.33	5.82
Sep		3.62	4.59	6.59	3.87	3.49	3.96	4.20	5.13	4.34	5.77
Oct		3.78	4.75	6.75	4.13	3.79	4.29	4.46	5.35	4.49	6.07
Nov		4.00	5.00	7.00	4.31	3.97	4.43	4.54	5.42	4.42	6.33

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

		M1	MZM	M2	M3
Percent change at an annual rate					
	2000	0.18	8.09	6.07	9.41
	2001	3.33	15.88	8.77	11.47
	2002	4.92	12.87	7.58	8.04
	2003	6.49	7.41	6.93	6.38
	2004	5.57	3.93	4.54	5.10
2003	1	8.38	7.85	6.90	6.69
	2	10.59	5.42	7.48	5.15
	3	7.63	10.46	7.69	7.59
	4	2.29	-2.08	-0.45	-0.46
2004	1	6.21	2.44	3.57	5.35
	2	5.88	8.59	7.75	9.14
	3	3.34	2.01	3.43	4.23
	4	5.71	2.78	5.77	4.03
2005	1	0.48	0.44	3.99	5.51
	2	-0.54	-0.48	1.69	5.88
	3	-1.96	3.42	3.85	8.27
2003	Nov	1.32	-3.65	-0.91	-2.58
	Dec	6.72	-1.96	0.72	0.04
2004	Jan	-1.50	2.62	2.66	7.72
	Feb	16.89	6.26	7.93	8.61
	Mar	11.57	9.16	7.61	10.03
	Apr	-0.20	8.85	7.23	8.25
	May	3.87	11.92	11.21	11.66
	Jun	5.76	1.83	2.08	4.89
	Jul	-6.79	-2.46	0.30	0.30
	Aug	15.81	2.50	3.98	4.57
	Sep	3.58	4.94	6.60	6.49
	Oct	0.95	0.08	5.31	1.43
	Nov	13.79	4.48	7.02	4.02
	Dec	-2.01	3.44	4.52	6.27
2005	Jan	-8.07	-0.89	3.45	6.65
	Feb	6.48	-2.58	2.83	4.56
	Mar	6.06	0.47	3.75	3.76
	Apr	-15.27	-0.62	-0.56	6.50
	May	10.98	-3.47	0.24	5.25
	Jun	0.81	6.08	6.08	10.61
	Jul	-17.49	0.91	1.75	3.52
	Aug	14.75	5.40	5.38	12.52
	Sep	-6.66	8.53	6.14	11.84
	Oct	3.75	6.64	7.15	9.85
	Nov	4.18	1.80	4.62	4.83

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; 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 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/msi/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** 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

$$f_t^* = 2.5 + \pi_{t-1} + (\pi_{t-1} - \pi^*)/2 + 100 \times (y_{t-1} - y_{t-1}^P)/2$$

to five alternative target inflation rates, $\pi^* = 0, 1, 2, 3, 4$ percent, where f_t^* is the implied federal funds rate, π_{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}^P 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

$$\Delta MB_t^* = \pi^* + (\text{10-year moving average growth of real GDP})$$
$$- (\text{4-year moving average of base velocity growth})$$

to five alternative target inflation rates, $\pi^* = 0, 1, 2, 3, 4$ percent, where ΔMB_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/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 $m = 1,..., 10$ 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),

$$R(m) = a_0 + (a_1 + a_2)(1 - e^{-m/50})/(m/50) - a_2 \times e^{-m/50},$$

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 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.

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.

Bank of England: U.K. note yields.

Board of Governors of the Federal Reserve System:
Monetary aggregates and components: H.6 release. Bank credit and components: H.8 release. Consumer credit: G.19 release. Required reserves, excess reserves, clearing balance contracts, and discount window borrowing: H.4.1 and H.3 releases. Interest rates: H.15 release. Nonfinancial commercial paper: Board of Governors website. Nonfinancial debt: Z.1 release. M2 own rate.

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 Philadelphia: Survey of Professional Forecasters inflation expectations.

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.

U.S. Department of the Treasury: U.S. security yields.

References

Anderson, Richard G. and Robert H. Rasche (1996a). "A Revised Measure of the St. Louis Adjusted Monetary Base," Federal Reserve Bank of St. Louis *Review*, March/April, *78*(2), pp. 3-13.*

____ and ____(1996b). "Measuring the Adjusted Monetary Base in an Era of Financial Change," Federal Reserve Bank of St. Louis *Review*, November/December, *78*(6), pp. 3-37.*

____ and ____(2001). "Retail Sweep Programs and Bank Reserves, 1994-1999," Federal Reserve Bank of St. Louis *Review*, January/February, *83*(1), pp. 51-72.*

____ and ____ , with Jeffrey Loesel (2003). "A Reconstruction of the Federal Reserve Bank of St. Louis Adjusted Monetary Base and Reserves," Federal Reserve Bank of St. Louis *Review*, September/October, *85*(5), pp. 39-70.*

____ , Barry E. Jones and Travis D. Nesmith (1997). "Special Report: The Monetary Services Indexes Project of the Federal Reserve Bank of St. Louis," Federal Reserve Bank of St. Louis *Review*, January/February, *79*(1), pp. 31-82.*

McCallum, Bennett T. (1988). "Robustness Properties of a Monetary Policy Rule," *Carnegie-Rochester Conference Series on Public Policy*, vol. 29, pp. 173-204.

____(1993). "Specification and Analysis of a Monetary Policy Rule for Japan," Bank of Japan *Monetary and Economic Studies*, November, pp. 1-45.

Motley, Brian (1988). "Should M2 Be Redefined?" Federal Reserve Bank of San Francisco *Economic Review*, Winter, pp. 33-51.

Nelson, Charles R. and Andrew F. Siegel (1987). "Parsimonious Modeling of Yield Curves," *Journal of Business*, October, pp. 473-89.

Poole, William (1991). Statement before the Subcommittee on Domestic Monetary Policy of the Committee on Banking, Finance and Urban Affairs, U.S. House of Representatives, November 6, 1991. Government Printing Office, Serial No. 102-82.

Sharpe, William F. (1997). *Macro-Investment Analysis*, on-line textbook available at www.stanford.edu/~wfsharpe/mia/mia.htm.

Shiller, Robert (1990). "The Term Structure of Interest Rates," *Handbook of Monetary Economics*, vol. 1, B. Friedman and F. Hahn, eds., pp. 627-722.

Taylor, John B. (1993). "Discretion versus Policy Rules in Practice," *Carnegie-Rochester Conference Series on Public Policy*, vol. 39, pp. 195-214.

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