No Volatility, No Forecasting Power for the Term Spread

The recent disassociation between the term spread and the real growth rate can be explained in part by the finance fundamentals behind the concept of the term spread. The term spread, commonly defined as the difference between the yields on 10-year U.S. government bonds and 3-month Treasury bills, can be interpreted as a risk premium: the additional amount of compensation required to commit wealth into long-term investments in the face of unanticipated inflation shocks. The reasoning is simple: Should inflation accelerate unexpectedly, nominal interest rates are likely to promptly increase. While an investor buying T-bills could access higher yields quickly, an investor who has purchased bonds could not and will suffer a loss since the new nominal interest rates are higher than the bond's rate. Because this loss may be substantial if the bond is far from maturity, bond investors require a reward in the form of a term spread.[1]

We can quantify inflation risk by using the volatility of long-term bond yields. If there is substantial inflation risk, investors will tend to revise often their expectations of future inflation rates. This process affects long-term bond prices and causes volatility in their yields.

If inflationary risks decline independently of business cycle conditions, long-term bond yields become less volatile and the quantity of risk declines; this causes the term spread to decrease as well. The table shows this has been true over the past 26 years. In the Volcker era, the average realized (computed using daily yields), annualized volatility on 10-year government bonds had been 3.7 percent with a 2.2 percent term spread. Under Greenspan, the average realized volatility declines to 1.3 percent and the term spread declines to 1.7 percent.

However, the past two years have been characterized by a very low volatility in the bond market (0.7 percent) and virtually no term spread (0.04 percent). And the past decade has been characterized by less than half the risk formerly in the bond market, and at the same time the term spread has declined by approximately one-half.

Low or negative term spreads are conventionally seen as harbingers of recession. Between January 2005 and December 2007, the term spread declined to an average of 0.35 percent per year. Surprisingly, over the same period, real GDP maintained a brisk pace of almost 3 percent per year. Is it surprising the U.S. term spread has stopped forecasting real economic growth? No, because the term spread is a risk premium compensation that declines when risk disappears. For support, we have computed correlations between the term spread and the real GDP growth rate for two subsamples: 1981-94 and 1995-2007.[2] We find a high and statistically significant correlation in the first, high-volatility subsample, 0.36; with sufficient risk, the term spread is positive and varies to reflect anticipations of future business cycles. Over the second, low-volatility subsample the term spread has lost any association to real economic growth: The correlation is essentially zero (–0.03) and is not statistically significant. If the term spread mostly depends on inflationary risk and such risks disappear over time, poor forecasting performance is expected. It is ironic that the very success of Chairmen Greenspan and Bernanke at fighting inflation and anchoring inflationary expectations may have led to a new era in which forecasters and policymakers struggle with the loss of the term spread's predictive power. The business cycle remains difficult to forecast, although with stable inflation, the loss of a forecasting instrument seems a small price to pay.

—Massimo Guidolin and Allison K. Rodean

[1] The term spread also depends on other factors, e.g., the differential liquidity of the short and long term segments of the bond market and, in principle, the uncertainty of future real interest rates. Even though we recognize that these factors are like to be priced in the term spread, we simply assume a direct relationship between the term spread and the variance of excess long-term bond returns.

[2] Consistently with the literature, we apply a lag of 3 quarters in the relationship, i.e., real GDP growth today is predicted by the term spread 3 quarters ago. There has been some recent debate on whether and why the term spread may actual forecast business cycle conditions: See Anderson, R. "Yield Curve Inversions and Cyclical Peaks." Federal Reserve Bank of St. Louis *Monetary Trends*, May 2006.

Date range	Average term spread	Average votility	Number of months
Volcker era (9/1981–7/1987)	2.187	3.695	71
Greenspan era (8/1987–1/2006)	1.689	1.296	222
Bernanke era (2/2006–7/2007)	0.036	0.747	23
9/1981–12/1994	2.129	2.420	160
1/1995–7/2007	1.220	1.153	156

Views expressed do not necessarily reflect official positions of the Federal Reserve System.

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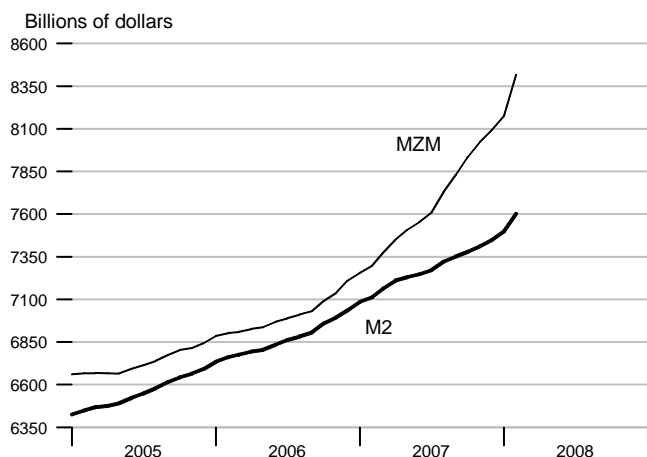
We welcome your comments addressed to:

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 ceased the publication of the M3 monetary aggregate. It also ceased publishing the following components: large-denomination time deposits, RPs, and eurodollars.
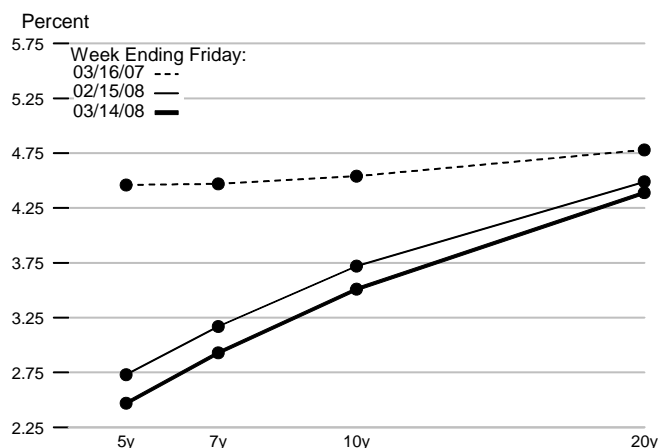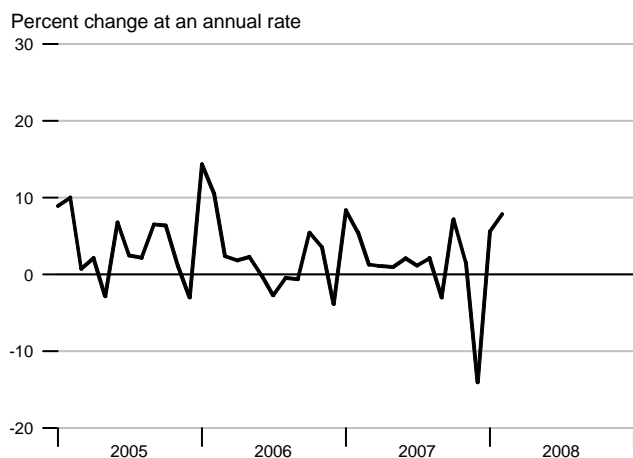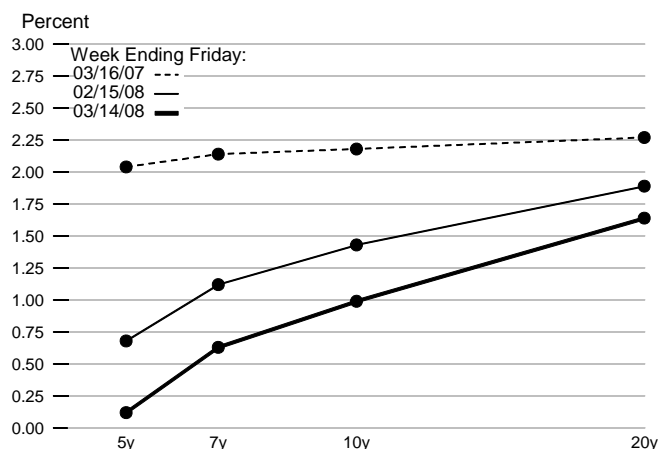
M2 and MZM

Billions of dollars

Treasury Yield Curve

Percent

Week Ending Friday:
03/16/07 ---
02/15/08 —
03/14/08 —

Adjusted Monetary Base

Percent change at an annual rate

Real Treasury Yield Curve

Percent

Week Ending Friday:
03/16/07 ---
02/15/08 —
03/14/08 —

Reserve Market Rates

Percent

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

Primary Credit Rate

Data available as of February 2008.

Inflation-Indexed Treasury Yield Spreads

Percent

Week Ending Friday:
03/16/07 ---
02/15/08 —
03/14/08 —
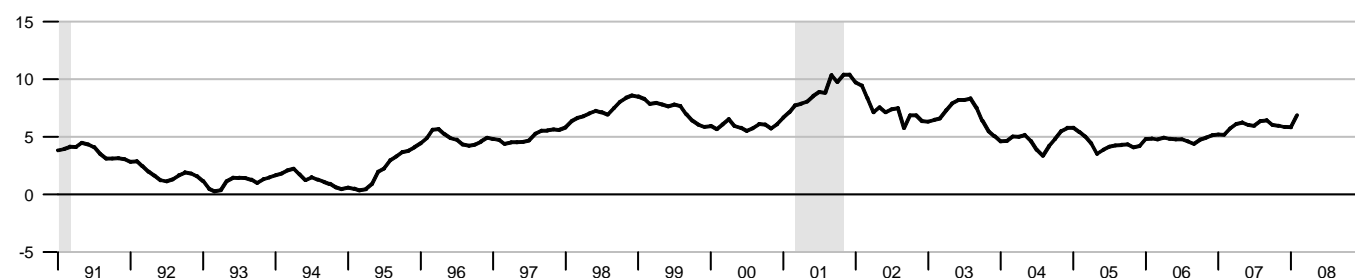
MZM and M1
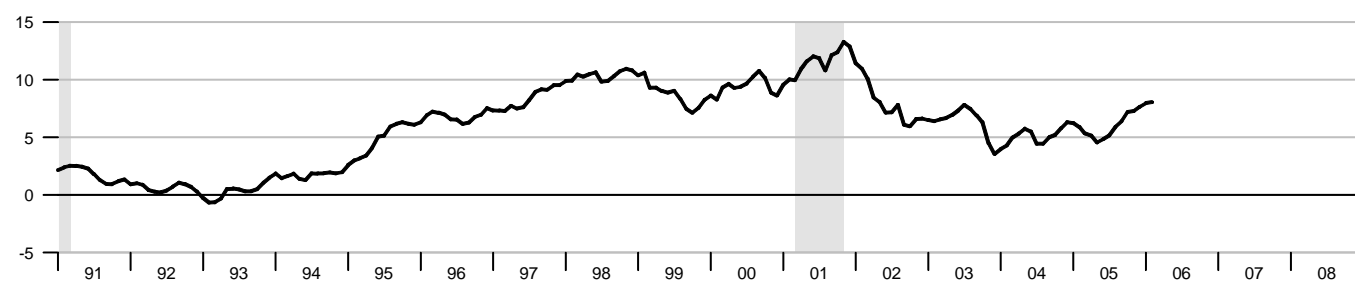
Percent change from year ago

MZM

M1

M2
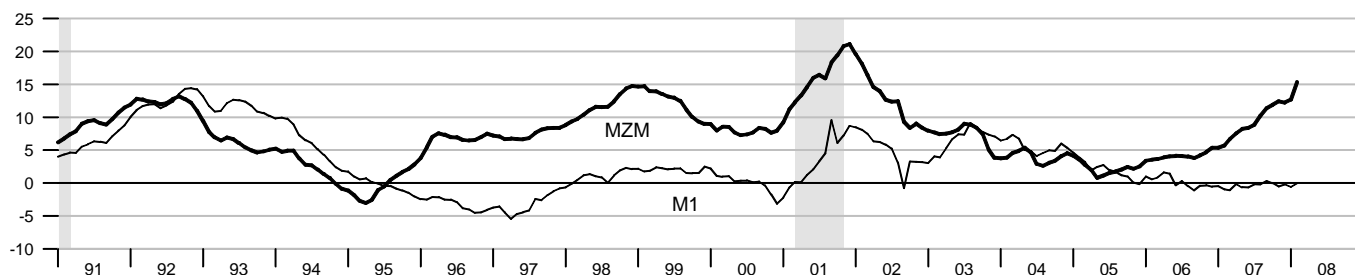
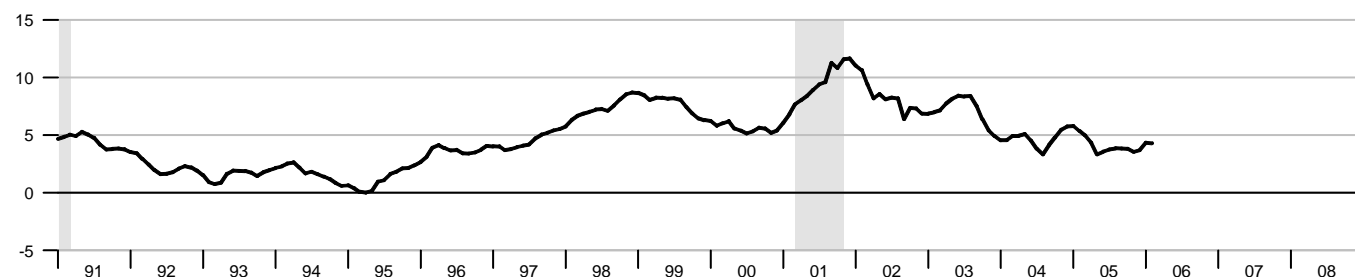Percent change from year ago

M3*

Percent change from year ago

*See table of contents for changes to the series.
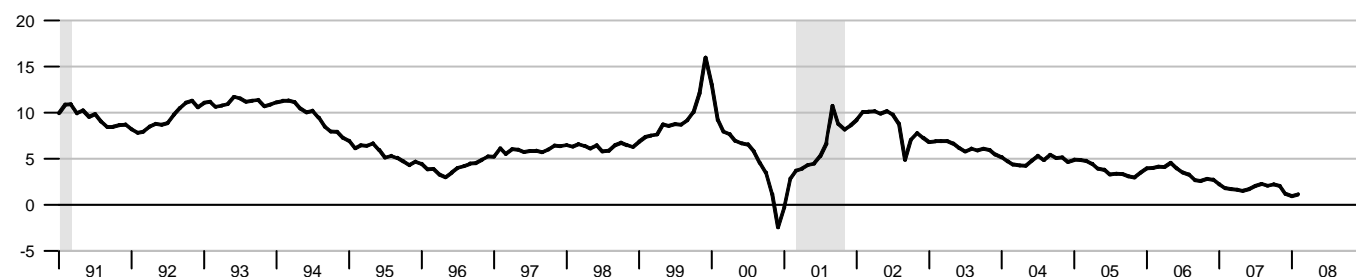
Monetary Services Index - M2**

Percent change from year ago

**We will not update the MSI series until we revise the code to accomodate the discontinuation of M3.

Adjusted Monetary Base

Percent change from year ago

Domestic Nonfinancial Debt

Percent change from year ago
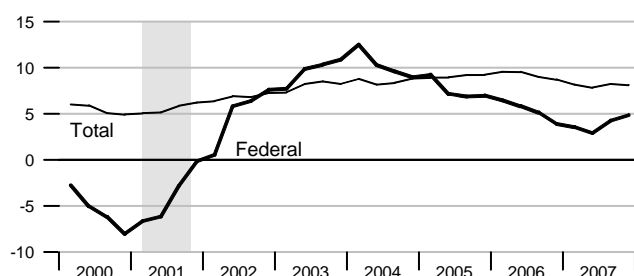
Currency Held by the Nonbank Public

Percent change from year ago
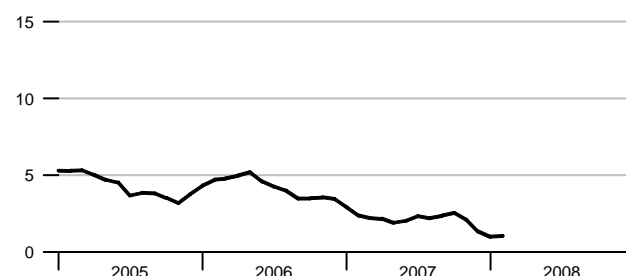
Time Deposits*

Percent change from year ago
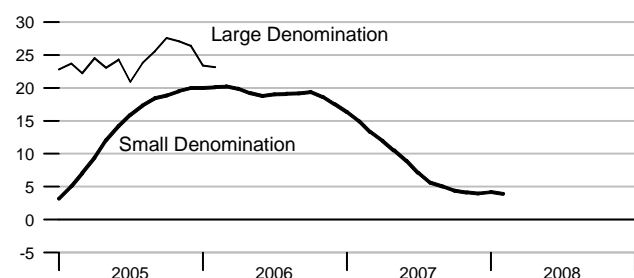
*See table of contents for changes to the series.

Checkable and Savings Deposits

Percent change from year ago
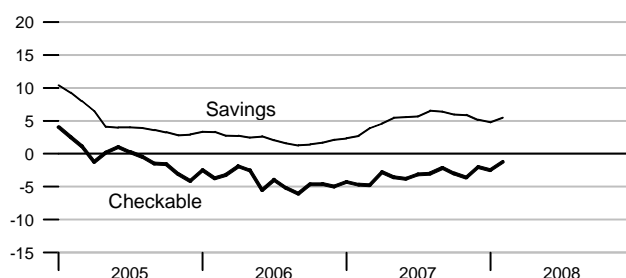
Money Market Mutual Fund Shares

Percent change from year ago
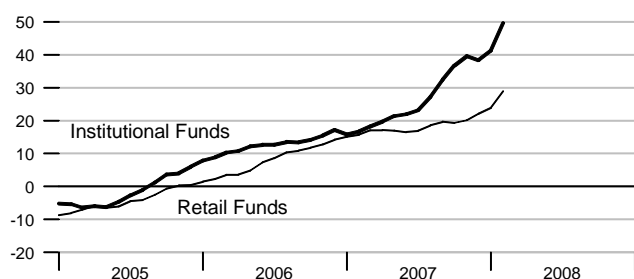
Repurchase Agreements and Eurodollars*

Billions of dollars   Billions of dollars
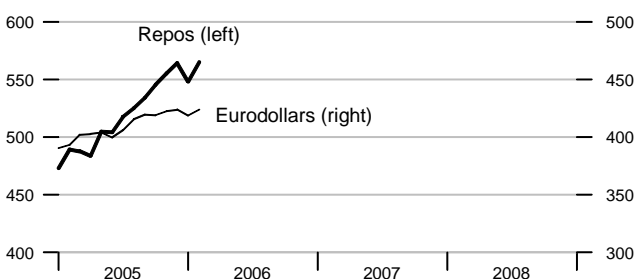
*See table of contents for changes to these series.

M1

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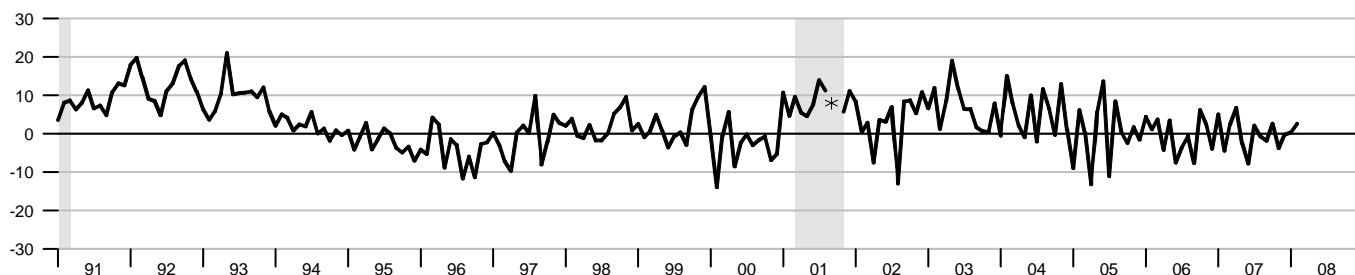
*Actual values for September and October 2001 are 55.87 and -38.35 percent rate, respectively.

MZM

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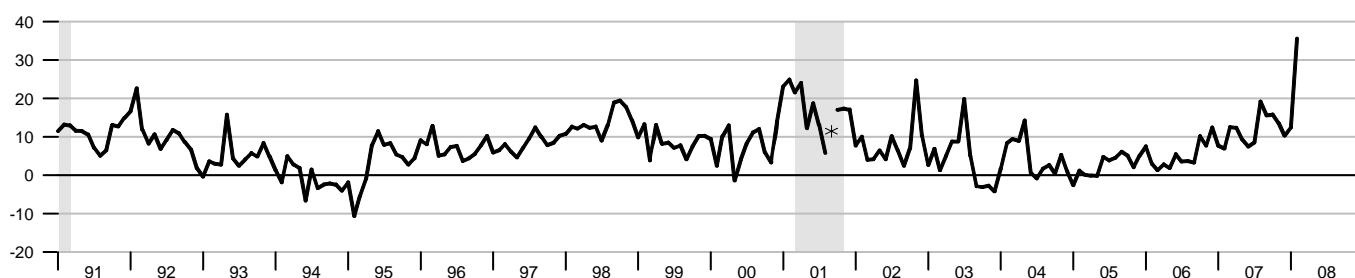
*Actual value for September 2001 is 39.41 percent rate.

M2

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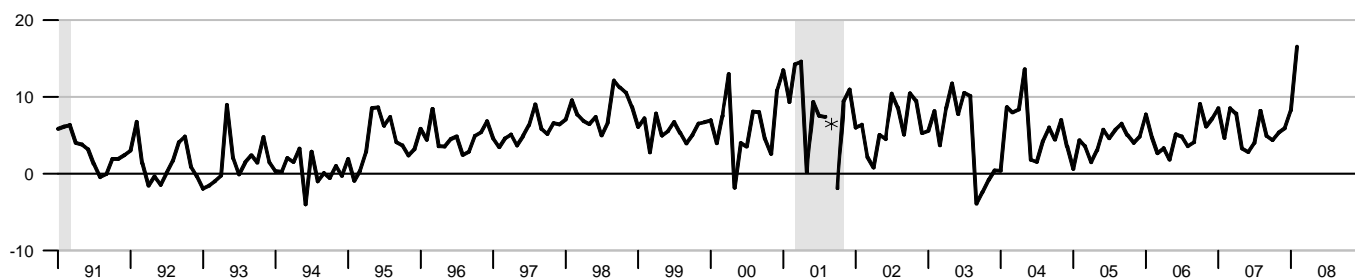
*Actual value for September 2001 is 24.90 percent rate.

M3*

Percent change at an annual rate
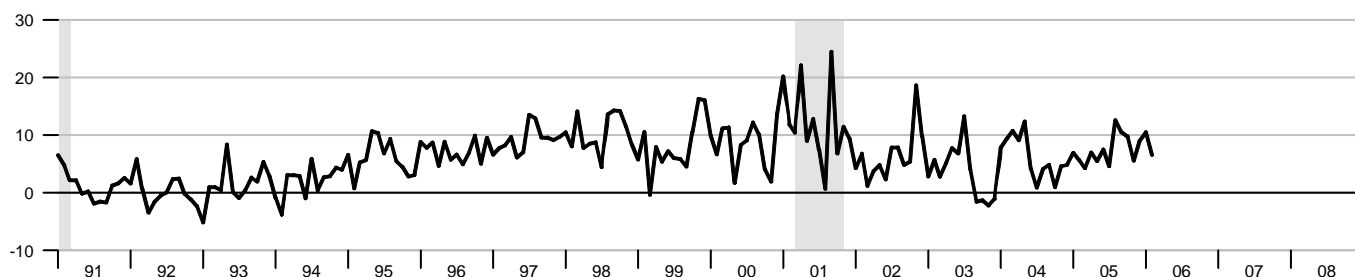
*See table of contents for changes to the series.

Adjusted and Required Reserves

Billions of dollars

Adjusted

Required
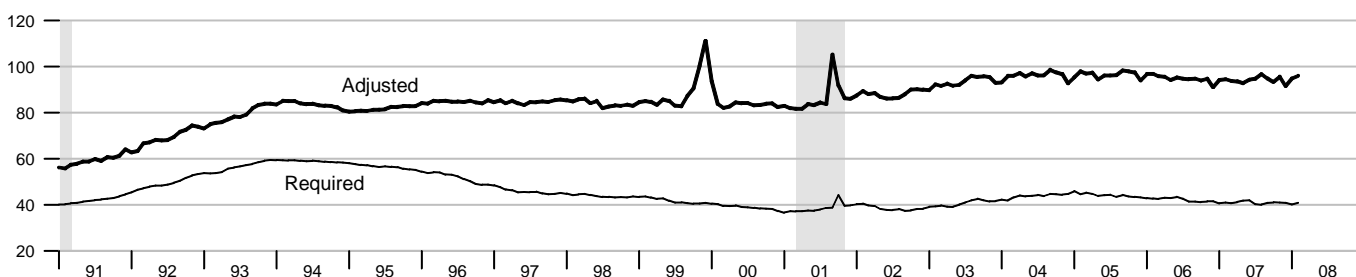
Total Borrowings, nsa

Billions of dollars
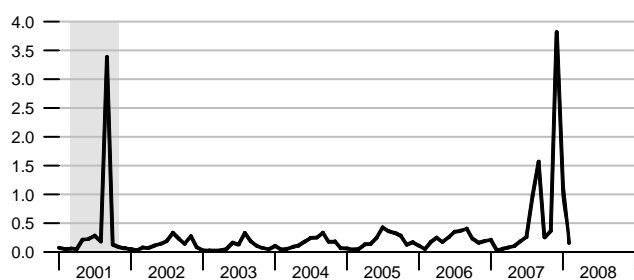
* Total borrowings include loans to depository
institutions for primary, secondary, and
seasonal credit, but exclude term auction credit.

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
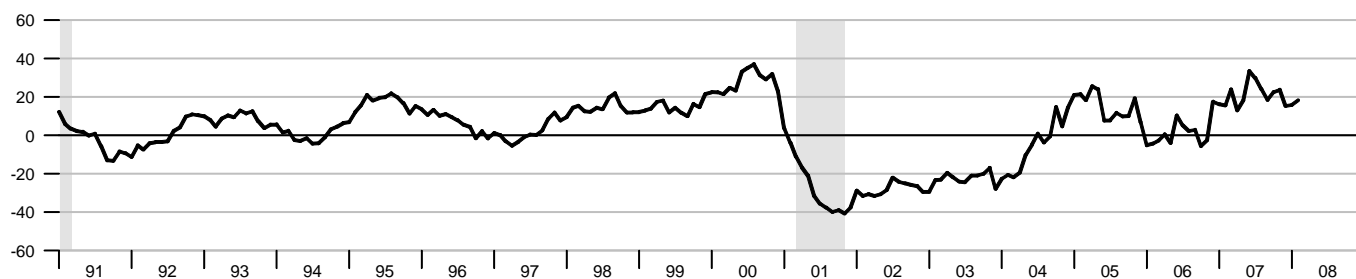
As of April 10, 2006, the Federal Reserve Board made major changes to its commercial paper calculations.
For more information, please refer to http://www.federalreserve.gov/releases/cp/about.htm.

Consumer Credit

Percent change from year ago
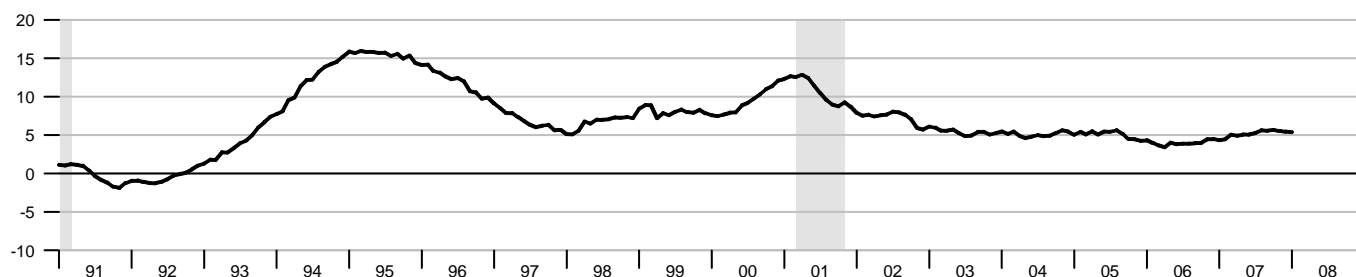
Inflation and 1-Year-Ahead Inflation Expectations

Percent

Humphrey-Hawkins CPI Inflation Range

Federal Reserve Bank
of Philadelphia

CPI Inflation

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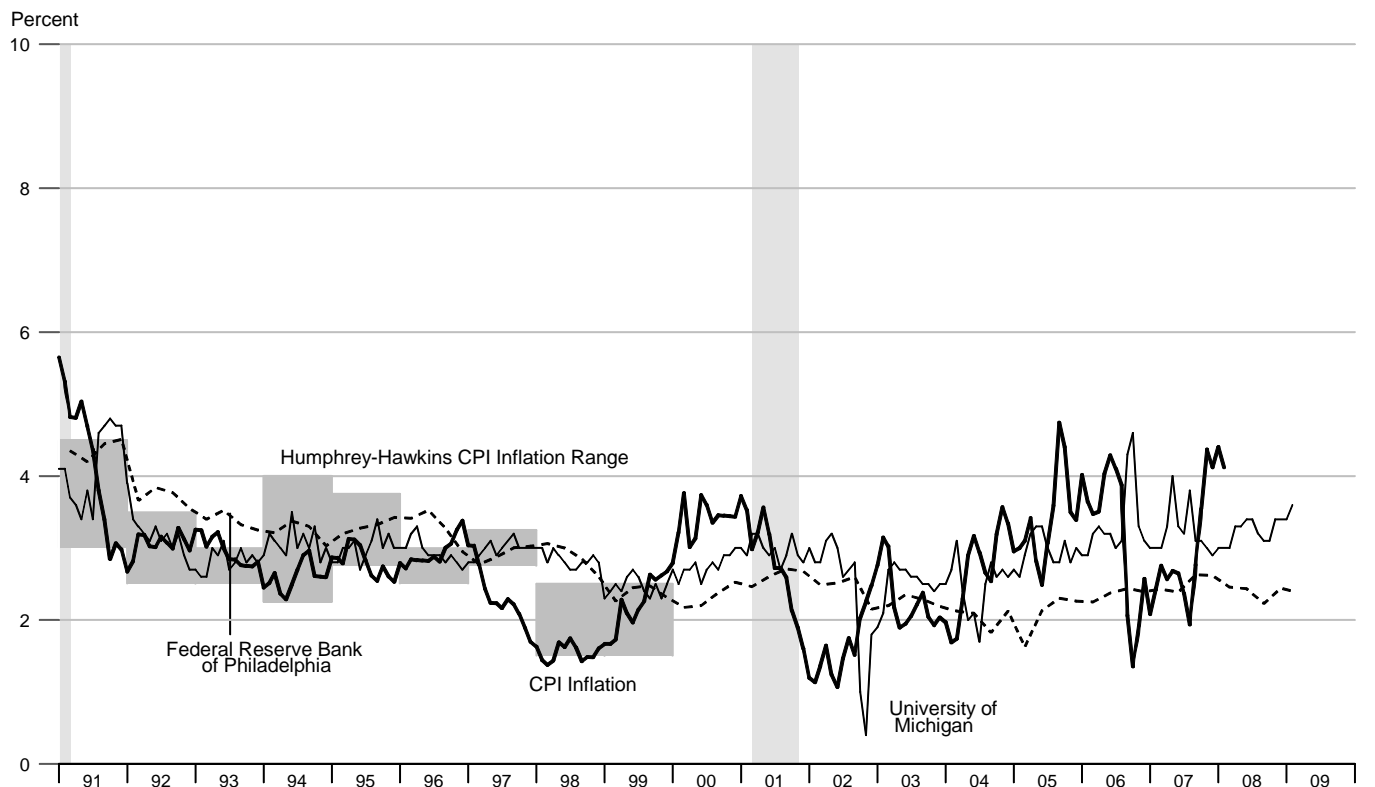
The shaded region shows the Humphrey-Hawkins CPI inflation range. Beginning in January 2000, the Humphrey-Hawkins inflation range was reported using the PCE price index and therefore is not shown on this graph. See notes on page 19.

Treasury Security Yield Spreads

Yield to maturity

10-Year less 3-Month T-Bill

10-Year less 3-Year Note

3-Year less 3-Month T-Bill
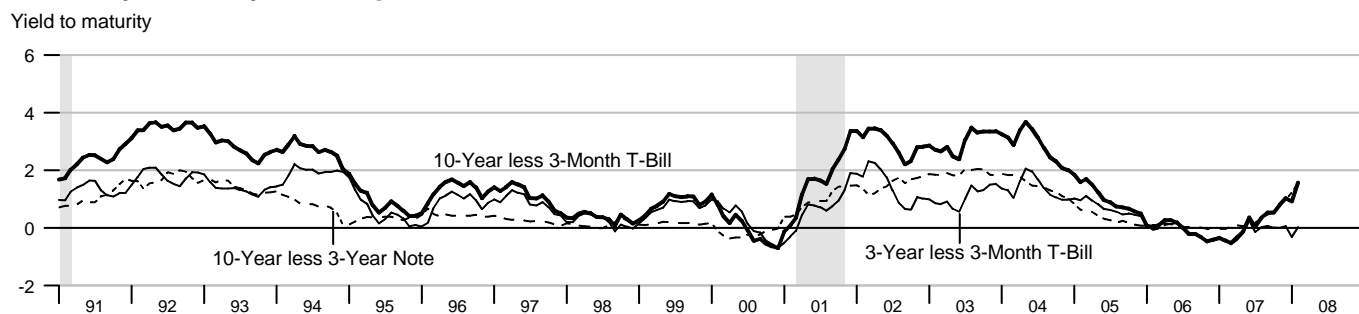
Real Interest Rates

Percent, Real rate = Nominal rate less year-over-year CPI inflation
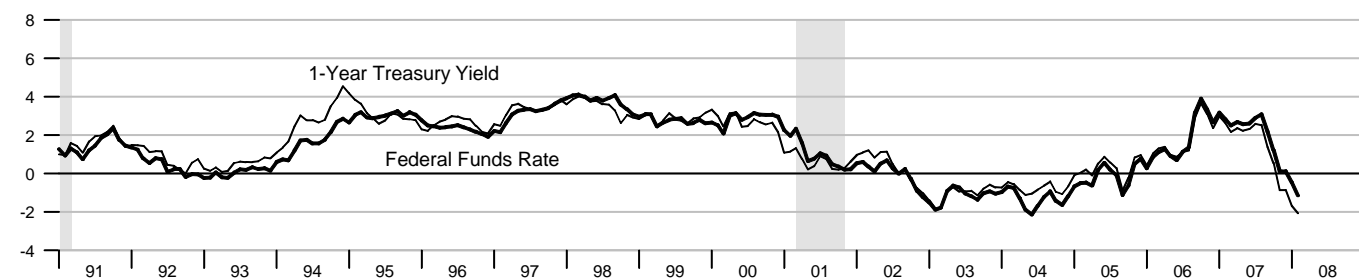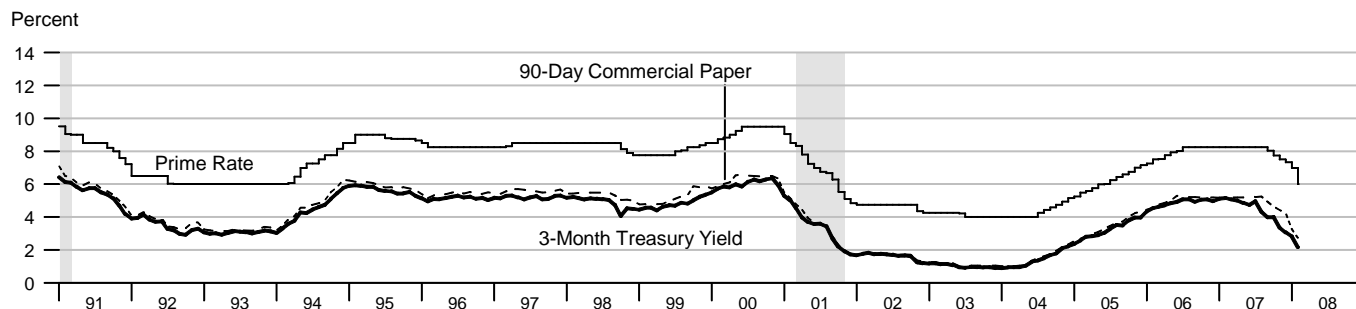
1-Year Treasury Yield

Federal Funds Rate

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
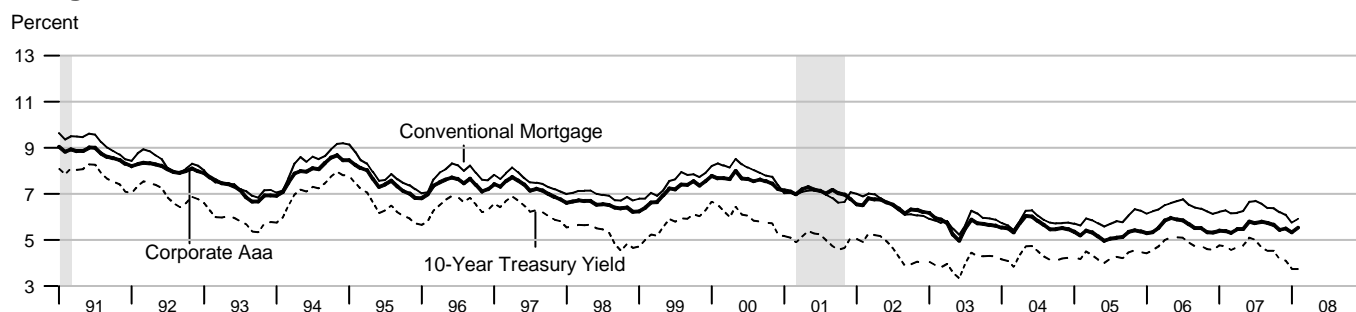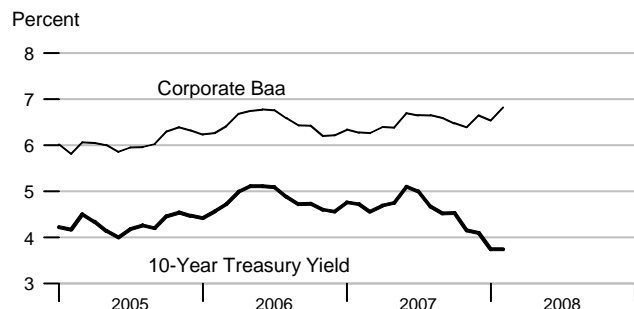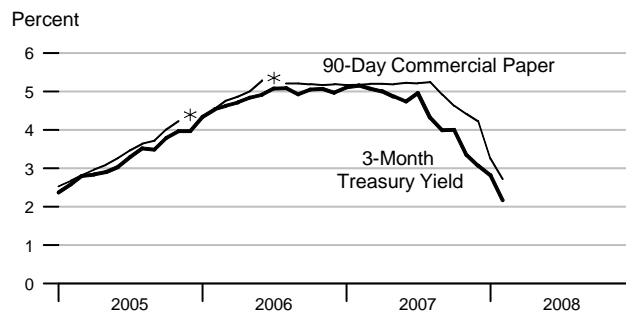
*90-Day Commercial Paper data are not available for December
2005, January 2006, and July 2006.

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

Percent

Intended Federal
Funds Rate

Discount Rate

Primary Credit
Rate

Data available as of February 2008.

Federal Funds Rate and Inflation Targets

Percent

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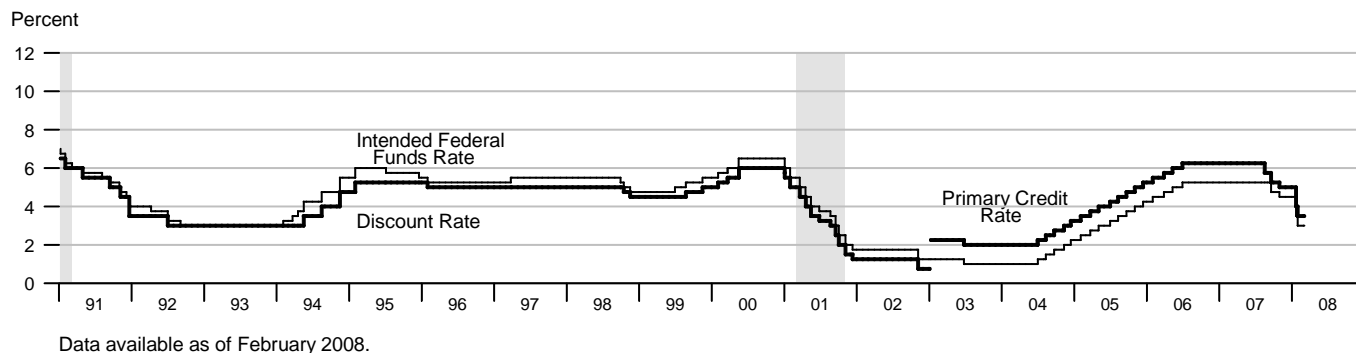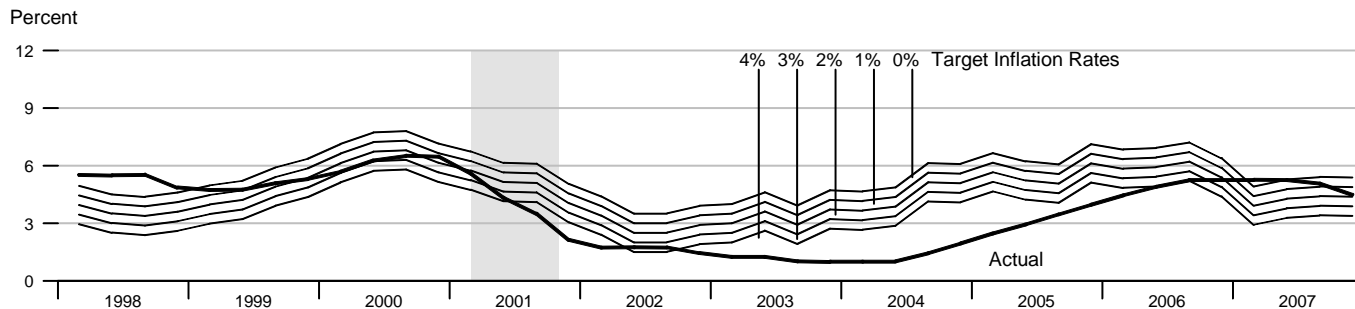
Actual

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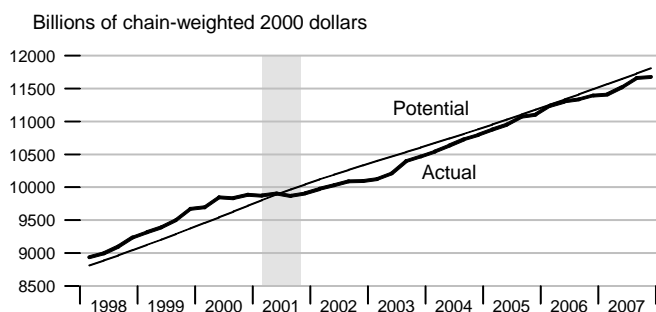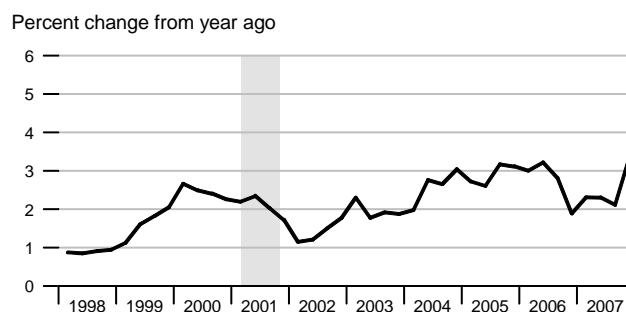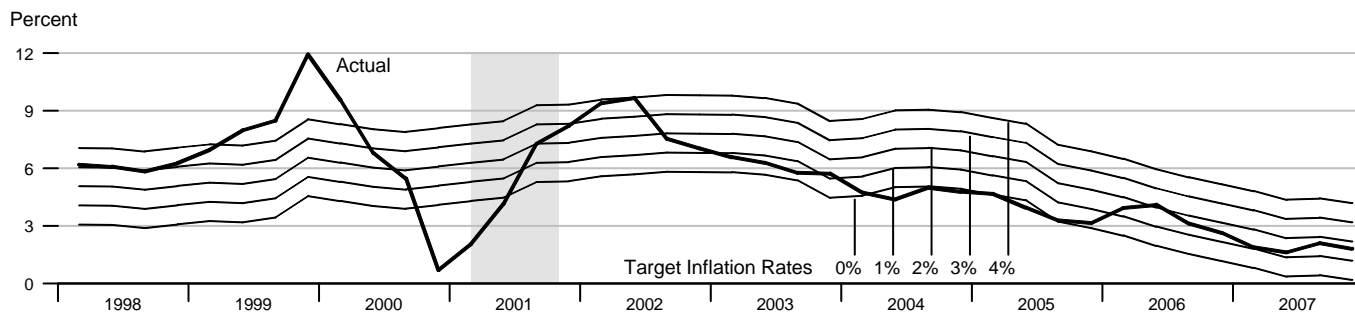
*Modified for the effects of sweeps programs on reserve demand.
Calculated base growth is based on McCallum's rule. Actual base growth is percent change from year ago. See notes on page 19.

Components of McCallum's Rule

Monetary Base Velocity Growth
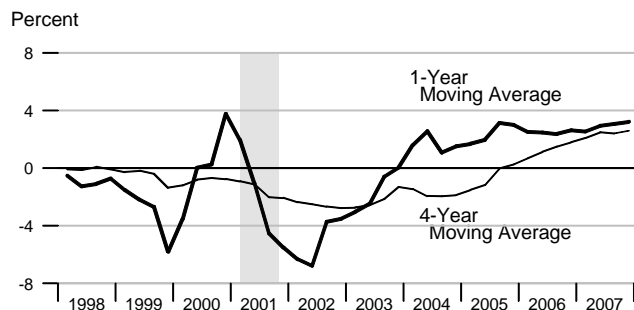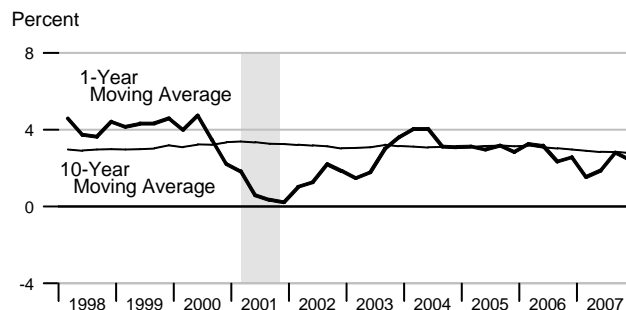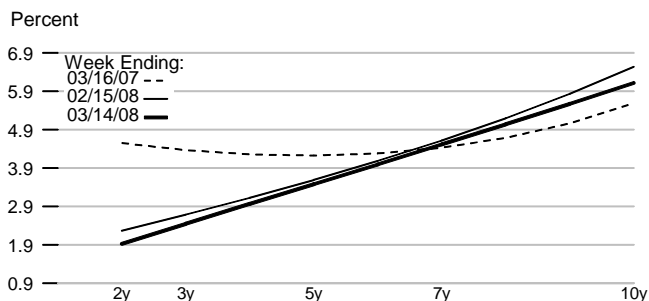
Percent

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:
03/16/07 - -
02/15/08 —
03/14/08 —

6.9
5.9
4.9
3.9
2.9
1.9
0.9

2y   3y   5y   7y   10y

Rates on 3-Month Eurodollar Futures

Percent, daily data

3.9
3.6
3.3
3.0
2.7
2.4
2.1

Mar 2008

Apr 2008

May 2008

01/14 01/21 01/28 02/04 02/11 02/18 02/25 03/03 03/10 03/17

Rates on Selected
Federal Funds Futures Contracts

Percent, daily data

3.7
3.4
3.1
2.8
2.5
2.2
1.9
1.6

Mar 2008

Apr 2008

May 2008

01/14 01/21 01/28 02/04 02/11 02/18 02/25 03/03 03/10 03/17

Rates on Federal Funds Futures
on Selected Dates

Percent

3.6
3.3
3.0
2.7
2.4
2.1
1.8
1.5

01/11/2008

02/15/2008

03/14/2008

Mar   Apr   May   Jun   Jul   Aug

Contract Month
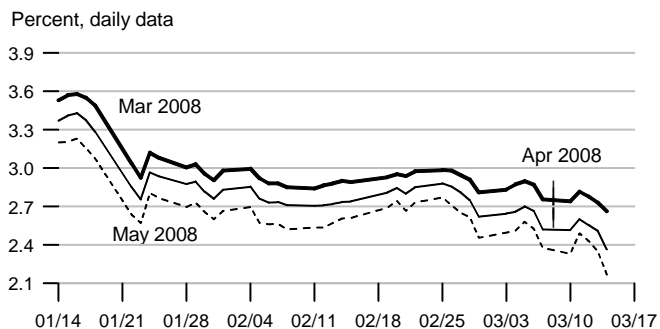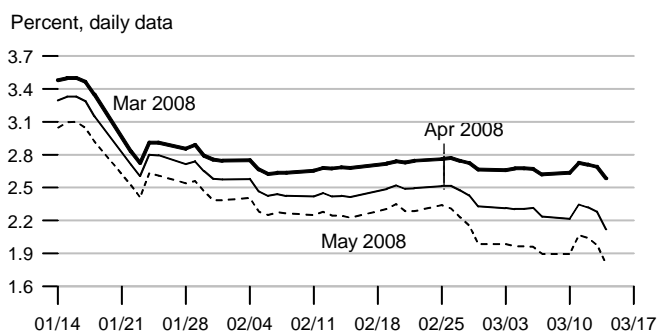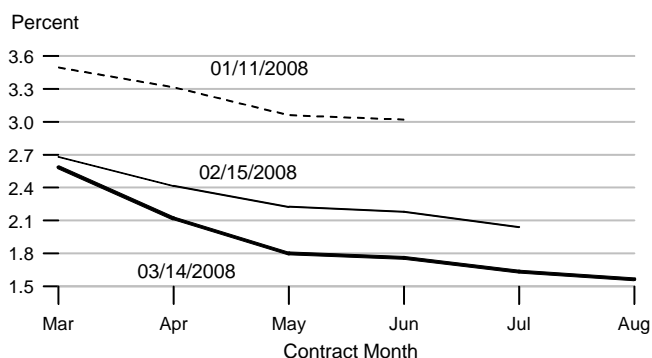
Inflation-Indexed Treasury Securities

Weekly data

Percent

3
2
1
0

2006   2007   2008   2009

20
15
10
5

Maturity

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

Inflation-Indexed Treasury Yield Spreads

Weekly data

Percent

3.5
2.5
1.5
0.5

2006   2007   2008   2009

20
15
10
5

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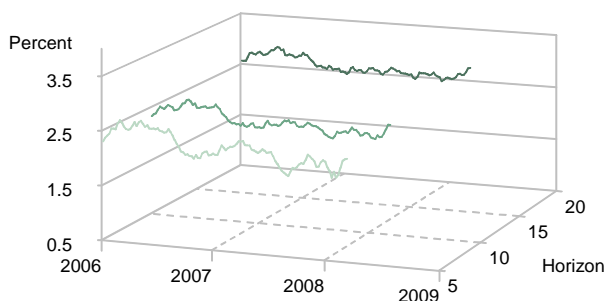
Note: Yield spread is between nominal and inflation-indexed
constant maturity U.S. Treasury securities.

Inflation-Indexed
10-Year Government Notes

Percent, weekly data

3

2

1

0

U.S.

U.K.

France

2004   2005   2006   2007   2008
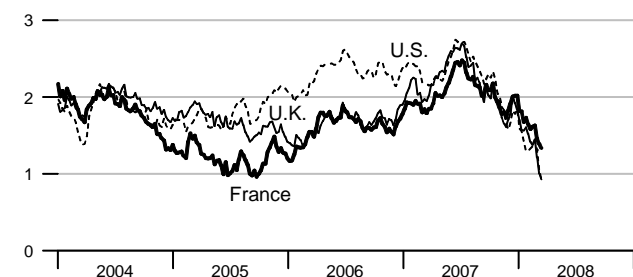
Inflation-Indexed
10-Year Government Yield Spreads

Percent, weekly data

4

3

2

1

0

U.K.

U.S.

France

2004   2005   2006   2007   2008
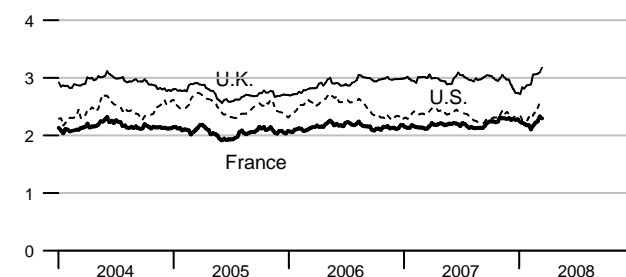
Velocity

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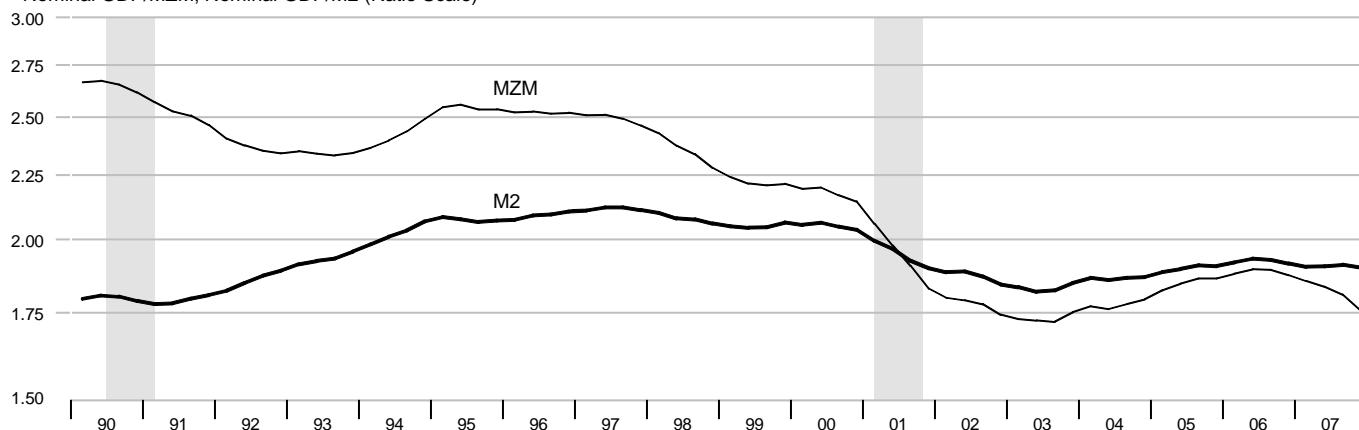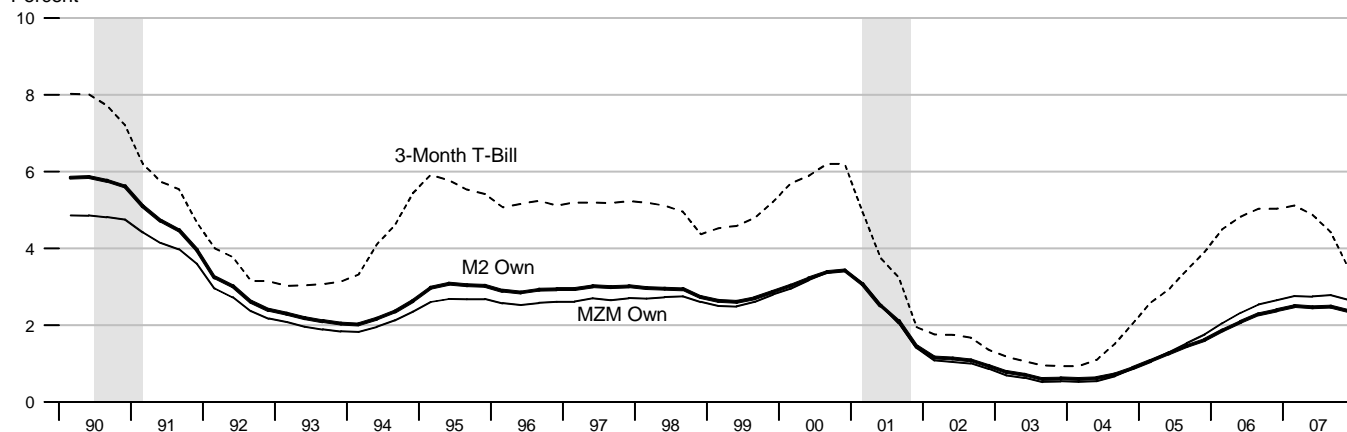
MZM

M2

Interest Rates

Percent

3-Month T-Bill

M2 Own

MZM Own

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
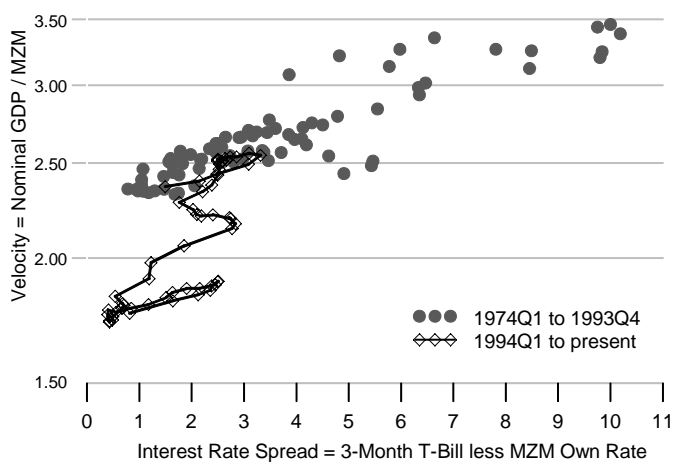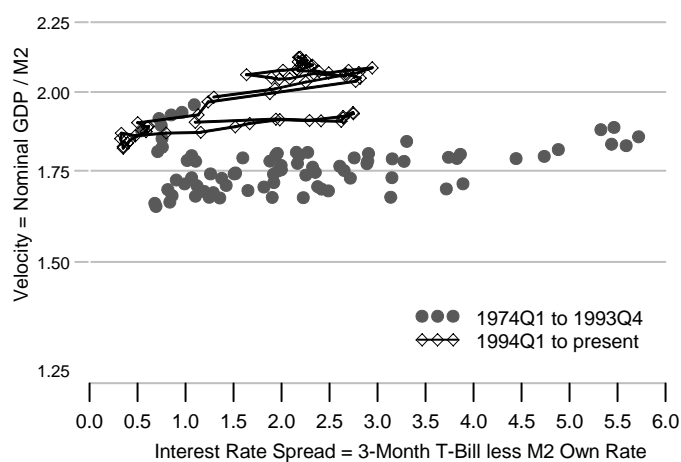
Gross Domestic Product

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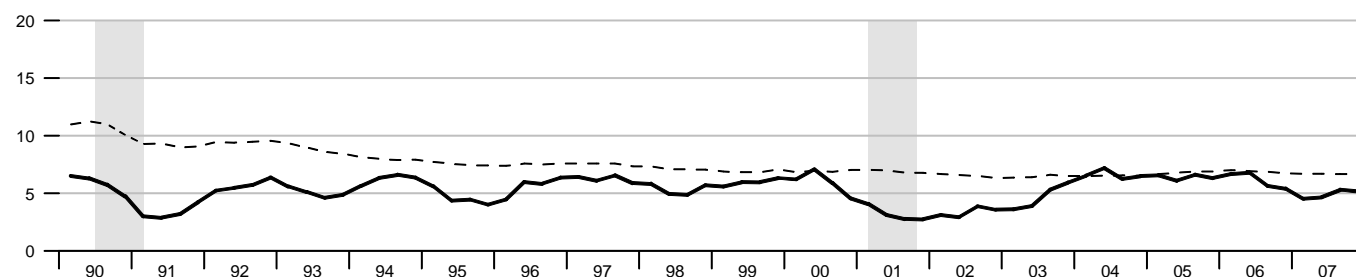
Dashed lines indicate 10-year moving averages.

Real Gross Domestic Product

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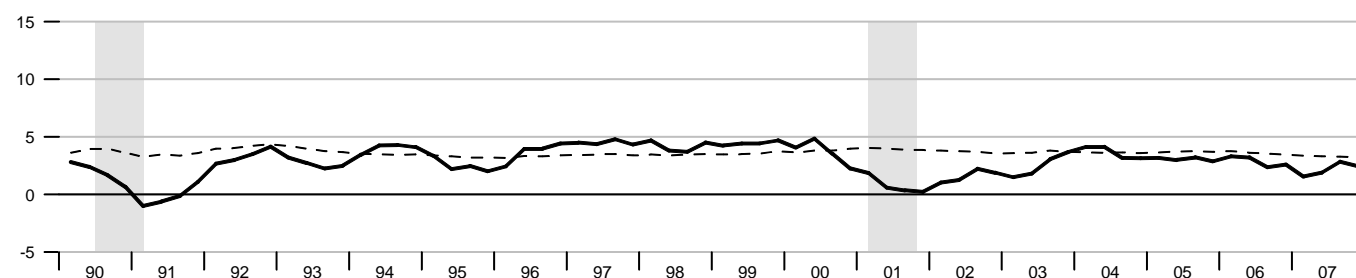
Dashed lines indicate 10-year moving averages.

Gross Domestic Product Price Index

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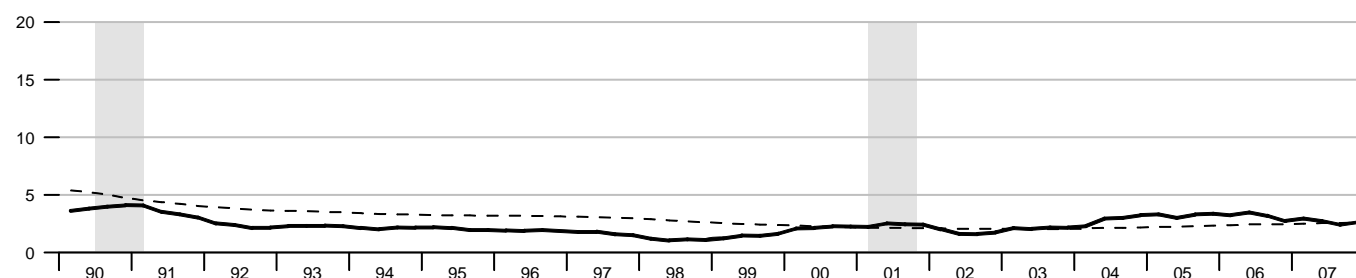
Dashed lines indicate 10-year moving averages.

M2

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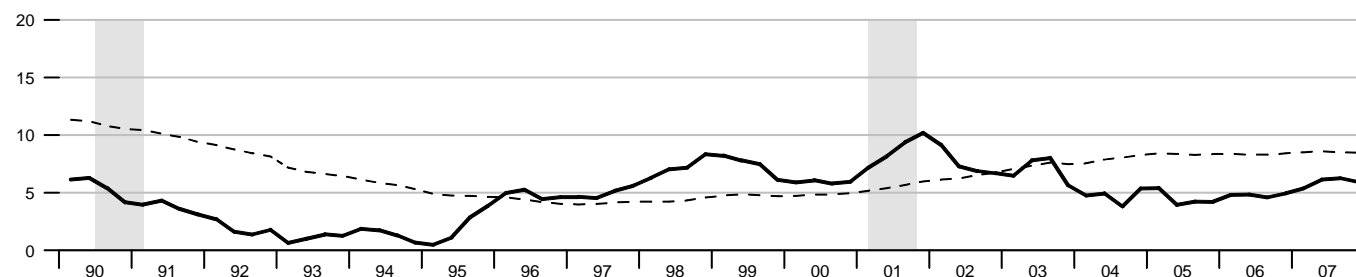
Dashed lines indicate 10-year moving averages.

Bank Credit

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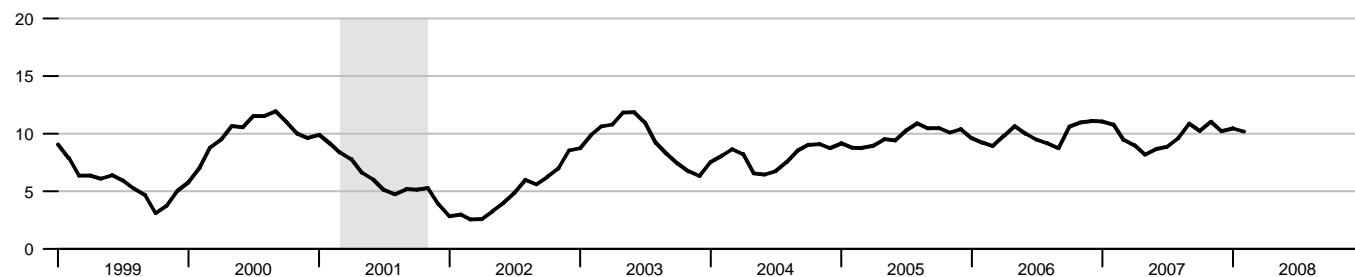
Investment Securities in Bank Credit at Commercial Banks

Percent change from year ago

Total Loans and Leases in Bank Credit at Commercial Banks

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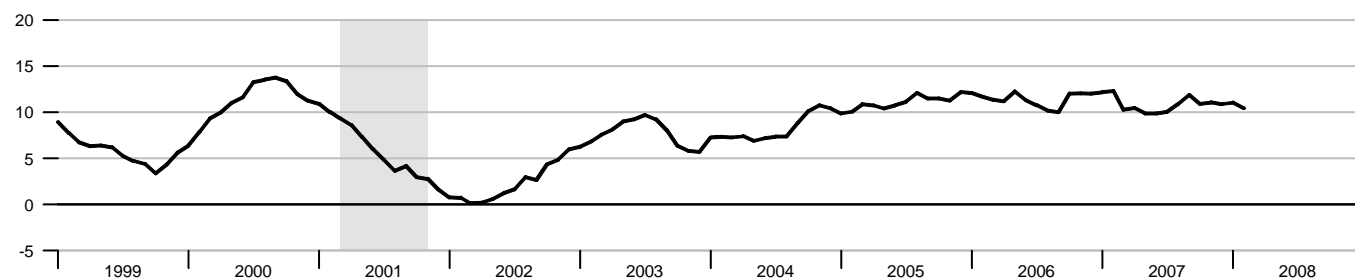
Commercial and Industrial Loans at Commercial Banks

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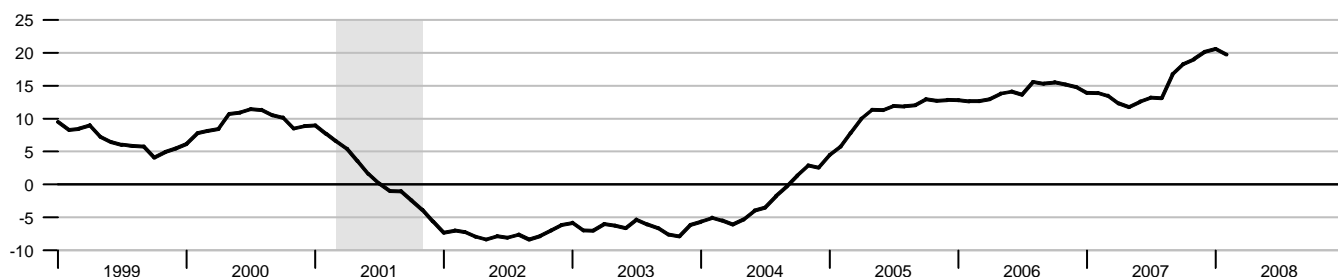
Standard & Poor's 500
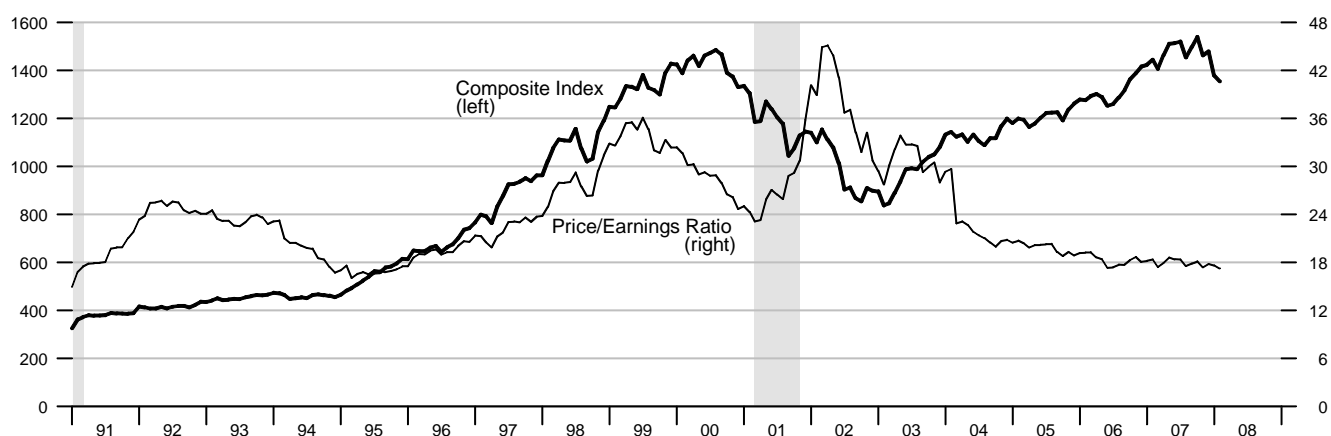
Recent Inflation and Long-Term Interest Rates

	Consumer Price Inflation Rates				Long-Term Government Bond Rates			
	Percent change from year ago				Percent			
	2007Q1	2007Q2	2007Q3	2007Q4	Nov07	Dec07	Jan08	Feb08
United States	2.42	2.63	2.36	4.01	4.15	4.10	3.74	3.74
Canada	1.81	2.19	2.13	2.41	4.13	4.01	3.87	3.85
France	1.16	1.18	1.27	2.34	4.23	4.35	4.15	.
Germany	1.81	2.00	2.30	3.11	4.09	4.21	4.03	.
Italy	1.73	1.59	1.64	2.36	4.45	4.54	4.40	4.35
Japan	-0.03	-0.03	-0.16	0.53	1.52	1.54	1.44	1.45
United Kingdom	2.84	2.58	1.78	2.09	4.73	4.69	4.49	4.62

Inflation and Long-Term Interest Rate Differentials
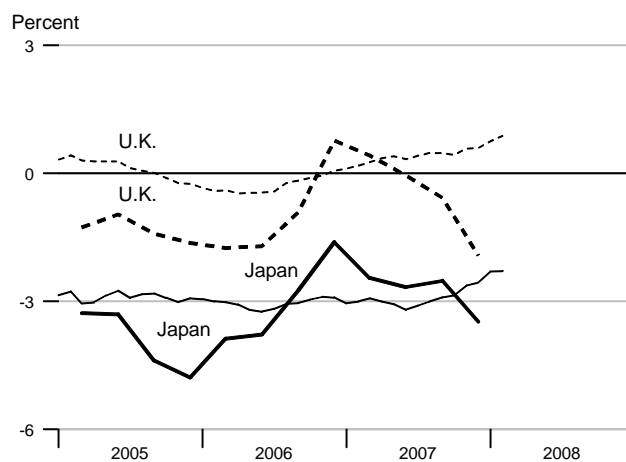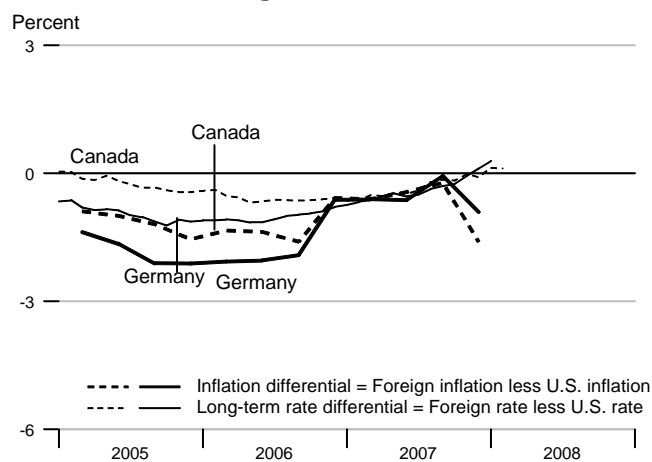
		Money Stock			Bank	Adjusted		
	M1	MZM	M2	M3*	Credit	Monetary Base	Reserves	MSI M2**
2003	1273.483	6327.288	5987.020	8787.321	6117.884	740.938	93.325	315.192
2004	1344.422	6578.703	6269.297	9234.718	6603.256	776.768	96.129	329.873
2005	1371.780	6725.613	6547.741	9786.477	7249.102	806.627	96.558	343.539
2006	1374.716	6999.837	6861.928	10270.74	7964.545	835.013	94.887	
2007	1369.219	7637.497	7268.968		8748.191	850.600	94.185	
2005 1	1370.779	6664.907	6446.907	9528.052	7000.215	798.379	96.773	339.356
2	1367.567	6675.210	6496.824	9670.405	7166.294	802.566	95.998	341.280
3	1373.736	6742.246	6580.808	9859.294	7362.396	809.023	96.938	344.766
4	1375.036	6820.089	6666.423	10088.16	7467.503	816.538	96.525	348.753
2006 1	1381.849	6899.781	6757.209		7647.843	830.533	96.494	
2	1379.996	6944.253	6811.376		7893.807	836.330	95.026	
3	1367.890	7010.342	6883.345		8035.112	834.533	94.752	
4	1369.130	7144.973	6995.781		8281.418	838.655	93.276	
2007 1	1370.321	7308.915	7120.677		8446.306	846.370	94.184	
2	1373.255	7503.676	7229.148		8573.878	849.946	93.585	
3	1367.493	7722.119	7314.277		8821.392	852.275	95.424	
4	1365.808	8015.278	7411.771		9151.189	853.811	93.546	
2006 Feb	1380.879	6902.895	6760.952	10298.68	7651.351	832.401	96.867	353.943
Mar	1385.142	6910.325	6776.042		7723.808	834.035	95.826	
Apr	1380.275	6926.457	6794.768		7814.828	835.307	95.578	
May	1384.202	6937.359	6805.164		7928.049	836.887	94.200	
Jun	1375.511	6968.942	6834.196		7938.544	836.797	95.299	
Jul	1371.330	6989.543	6861.807		7986.255	834.900	94.811	
Aug	1370.539	7011.053	6882.340		8048.410	834.570	94.648	
Sep	1361.802	7030.431	6905.889		8070.671	834.130	94.797	
Oct	1368.774	7089.979	6958.083		8223.701	837.900	93.971	
Nov	1371.550	7135.539	6993.716		8272.884	840.382	94.765	
Dec	1367.066	7209.401	7035.544		8347.669	837.684	91.091	
2007 Jan	1372.772	7255.492	7085.468		8405.249	843.515	94.206	
Feb	1367.716	7297.609	7113.031		8477.644	847.350	94.518	
Mar	1370.475	7373.645	7163.533		8456.026	848.244	93.829	
Apr	1378.143	7449.674	7210.318		8517.890	848.994	93.636	
May	1375.274	7507.337	7230.039		8576.720	849.681	92.838	
Jun	1366.348	7554.018	7247.086		8627.025	851.164	94.280	
Jul	1368.733	7607.648	7271.197		8694.464	851.985	94.726	
Aug	1367.909	7729.157	7320.807		8821.489	853.486	96.687	
Sep	1365.838	7829.552	7350.827		8948.224	851.353	94.860	
Oct	1368.754	7932.645	7377.663		9066.904	856.425	93.419	
Nov	1364.476	8022.066	7410.566		9186.164	857.523	95.624	
Dec	1364.194	8091.123	7447.083		9200.498	847.485	91.596	
2008 Jan	1364.589	8174.893	7498.308		9284.530	851.416	94.840	
Feb	1367.535	8417.353	7601.634		9341.967	856.980	96.034	

Note: All values are given in billions of dollars. *See table of contents for changes to the series.

**We will not update the MSI series until we revise the code to accommodate the discontinuation of M3.

		Federal Funds	Primary Credit Rate	Prime Rate	3-mo CDs	Treasury Yields			Corporate Aaa Bonds	Municipal Aaa Bonds	Conventional Mortgage
						3-mo	3-yr	10-yr			
	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
	2005	3.21	4.19	6.19	3.51	3.21	3.93	4.29	5.23	4.28	5.86
	2006	4.96	5.96	7.96	5.15	4.85	4.77	4.79	5.59	4.15	6.41
	2007	5.02	5.86	8.05	5.27	4.47	4.34	4.63	5.56	4.13	6.34
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
	4	3.98	4.97	6.97	4.30	3.91	4.37	4.49	5.38	4.45	6.22
2006	1	4.46	5.43	7.43	4.72	4.50	4.58	4.57	5.39	4.29	6.24
	2	4.91	5.90	7.90	5.18	4.83	4.98	5.07	5.89	4.36	6.60
	3	5.25	6.25	8.25	5.39	5.03	4.87	4.90	5.68	4.13	6.56
	4	5.25	6.25	8.25	5.32	5.03	4.65	4.63	5.39	3.82	6.24
2007	1	5.26	6.25	8.25	5.31	5.12	4.68	4.68	5.36	3.91	6.22
	2	5.25	6.25	8.25	5.32	4.87	4.76	4.85	5.58	4.13	6.37
	3	5.07	5.93	8.18	5.42	4.42	4.41	4.73	5.75	4.27	6.55
	4	4.50	5.02	7.52	5.02	3.47	3.50	4.26	5.53	4.24	6.23
2006	Feb	4.49	5.50	7.50	4.72	4.54	4.64	4.57	5.35	4.33	6.25
	Mar	4.59	5.53	7.53	4.88	4.63	4.74	4.72	5.53	4.29	6.32
	Apr	4.79	5.75	7.75	5.03	4.72	4.89	4.99	5.84	4.36	6.51
	May	4.94	5.93	7.93	5.15	4.84	4.97	5.11	5.95	4.38	6.60
	Jun	4.99	6.02	8.02	5.35	4.92	5.09	5.11	5.89	4.35	6.68
	Jul	5.24	6.25	8.25	5.46	5.08	5.07	5.09	5.85	4.41	6.76
	Aug	5.25	6.25	8.25	5.38	5.09	4.85	4.88	5.68	4.10	6.52
	Sep	5.25	6.25	8.25	5.34	4.93	4.69	4.72	5.51	3.87	6.40
	Oct	5.25	6.25	8.25	5.33	5.05	4.72	4.73	5.51	3.91	6.36
	Nov	5.25	6.25	8.25	5.32	5.07	4.64	4.60	5.33	3.81	6.24
	Dec	5.24	6.25	8.25	5.32	4.97	4.58	4.56	5.32	3.76	6.14
2007	Jan	5.25	6.25	8.25	5.32	5.11	4.79	4.76	5.40	3.89	6.22
	Feb	5.26	6.25	8.25	5.31	5.16	4.75	4.72	5.39	3.95	6.29
	Mar	5.26	6.25	8.25	5.30	5.08	4.51	4.56	5.30	3.88	6.16
	Apr	5.25	6.25	8.25	5.31	5.01	4.60	4.69	5.47	3.99	6.18
	May	5.25	6.25	8.25	5.31	4.87	4.69	4.75	5.47	4.04	6.26
	Jun	5.25	6.25	8.25	5.33	4.74	5.00	5.10	5.79	4.36	6.66
	Jul	5.26	6.25	8.25	5.32	4.96	4.82	5.00	5.73	4.24	6.70
	Aug	5.02	6.01	8.25	5.49	4.32	4.34	4.67	5.79	4.30	6.57
	Sep	4.94	5.53	8.03	5.46	3.99	4.06	4.52	5.74	4.26	6.38
	Oct	4.76	5.24	7.74	5.08	4.00	4.01	4.53	5.66	4.20	6.38
	Nov	4.49	5.00	7.50	4.97	3.35	3.35	4.15	5.44	4.26	6.21
	Dec	4.24	4.83	7.33	5.02	3.07	3.13	4.10	5.49	4.25	6.10
2008	Jan	3.94	4.48	6.98	3.84	2.82	2.51	3.74	5.33	4.13	5.76
	Feb	2.98	3.50	6.00	3.06	2.17	2.19	3.74	5.53	4.42	5.92

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

		M1	MZM	M2	M3*
Percent change at an annual rate					
	2003	6.46	7.41	6.98	6.40
	2004	5.57	3.97	4.71	5.09
	2005	2.03	2.23	4.44	5.97
	2006	0.21	4.08	4.80	4.95
	2007	-0.40	9.11	5.93	
2005	1	0.02	0.23	3.14	5.63
	2	-0.94	0.62	3.10	5.98
	3	1.80	4.02	5.17	7.81
	4	0.38	4.62	5.20	9.29
2006	1	1.98	4.67	5.45	
	2	-0.54	2.58	3.21	
	3	-3.51	3.81	4.23	
	4	0.36	7.68	6.53	
2007	1	0.35	9.18	7.14	
	2	0.86	10.66	6.09	
	3	-1.68	11.64	4.71	
	4	-0.49	15.19	5.33	
2006	Feb	1.18	2.92	4.69	6.55
	Mar	3.70	1.29	2.68	
	Apr	-4.22	2.80	3.32	
	May	3.41	1.89	1.84	
	Jun	-7.53	5.46	5.12	
	Jul	-3.65	3.55	4.85	
	Aug	-0.69	3.69	3.59	
	Sep	-7.65	3.32	4.11	
	Oct	6.14	10.16	9.07	
	Nov	2.43	7.71	6.15	
	Dec	-3.92	12.42	7.18	
2007	Jan	5.01	7.67	8.52	
	Feb	-4.42	6.97	4.67	
	Mar	2.42	12.50	8.52	
	Apr	6.71	12.37	7.84	
	May	-2.50	9.29	3.28	
	Jun	-7.79	7.46	2.83	
	Jul	2.09	8.52	3.99	
	Aug	-0.72	19.17	8.19	
	Sep	-1.82	15.59	4.92	
	Oct	2.56	15.80	4.38	
	Nov	-3.75	13.53	5.35	
	Dec	-0.25	10.33	5.91	
2008	Jan	0.35	12.42	8.25	
	Feb	2.59	35.59	16.54	

*See table of contents for changes to the series.

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 year-over-year 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 7/15/2017. **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.

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