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Forecasting the Past:

The Case of U.S. Interest Rate Forecasts

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Keywords Interest rate forecasts · Forecast accuracy · U.S. bond market analysts · Topically orientated trend adjustment behavior

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Forecasting the past: The case of U.S. interest rate forecasts

Abstract This study evaluates 10-year US-Government bond yield forecasts and 3-month US-Treasury bill rate forecasts for the period between October 1989 and December 2004. In total, 136 forecast time series with around 13,800 forecast data were scrutinized. This makes it the most extensive analysis of interest rate forecasts so far. Not one of the forecast time series proved to be unbiased. In the majority of cases, the information from the past was not efficiently integrated into the forecasts. The sign accuracy is significantly better than random walk forecasts only in a small number of forecast time series. The modified Diebold-Mariano test for forecast encompassing shows that the information content of most of the forecast time series is lower than that of the naïve forecasts, the simple ARIMA models, the implicit forward rates and average interest rate expectations. The forecasting process is dominated by the present and past market situation.

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1 Introduction

Forecasts of the future movement of interest rates are of fundamental importance for many business decisions. This especially holds true for the banking sector. Commercial banks obtain a substantial profit contribution by maturity transformations. In which design and to which extent these maturity transformations are useful depends on the present and expected future movement of interest rates. Only if reliable interest rate forecasts can be generated do the risks arising from maturity transformations shrink to a manageable residual.

Interest rate forecasts are indispensable requirements for the successful implementation of active portfolio management strategies in the bond market. Both the proprietary trading and the asset management departments of investment banks thus depend on reliable interest rate forecasts. Among others, fundamental stock market and exchange rate forecasts are usually based on interest rate forecasts. Research departments also work out interest rate forecasts as input for further forecasts of the financial market.

Industrial companies create interest rate forecasts to achieve the best possible timing for their investments. Capital procurement cost in a high interest rate phase can amount to many times over the cost of finance in a low interest rate phase. Also, with regard to the future, medium- and long-term price policies should consider the interest rate as a cost issue.

Against the background of the important role interest rate forecasts play for various financial areas of responsibility within banks and industrial companies, it is of special interest whether U.S. companies succeed in dealing with this task, and if so, to which extent. This study takes up a series of examinations with various results.

Friedman (1980) finds that the interest rate forecasts which were analyzed proved to be biased. Throop (1981) concludes that the reviewed estimations of market professionals lead to better forecast results than an autoregressive forecasting equation based on the past history of the interest rate. Belongia (1987) shows that the reviewed interest rate forecasts by analysts foresee the correct trend in interest rate movements in less than 50% of cases. Additionally, the estimates made by analysts prove to be inferior to the random walk forecast. Dua (1988) comes to mixed conclusions. Depending on the forecast subject, forecast horizon, and forecasting period examined, the forecasts are partly better and partly worse than a naïve forecast. Simon (1989) shows that the analyzed forecasts for the Fed funds rate are only marginally better than the corresponding random walk forecasts. In a comparison of interest rate forecasts by different market experts with naïve forecasts, Hafer and Hein (1989) establish that depending on the reviewed period of time and the applied forecast error measure, sometimes the naïve forecast and sometimes the analysts' forecast provide minimally better results. This impression is broadly confirmed in a later study of Hafer, Hein, and MacDonald (1992).

Table 1 Studies on the accuracy of survey forecasts of interest rates

Study	Evaluated forecast subject	Source of data	Frequency of forecast	Period of time
Friedman (1980)	Rates of Fed funds, 3- and 12-month bills, 6-month Eurodollars, Utility bonds, Municipal bonds	Goldsmith-Nagan Bond and Money Market Letter	Quarterly	1969 – 1977
Throop (1981)	3-month US-Treasury bill rate	Goldsmith-Nagan Bond and Money Market Letter	Quarterly	1970 – 1979
Belongia (1987)	3-month US-Treasury bill rate	Wall Street Journal	Semi-annual	1981 – 1986
Dua (1988)	3- and 12-month US-Treasury bill rate, federal funds rate, rate on high-grade tax-exempt bonds, rate on Aaa utility bonds	Goldsmith-Nagan Bond and Money Market Letter / Federal Reserve Bulletin / The Bond Buyer	Quarterly	1972 – 1985
Simon (1989)	Fed funds rate	Money Market Services	Two-weekly	1984 – 1987
Hafer / Hein (1989)	3-month US-Treasury bill rate	Bond and Money Market Letter	Quarterly	1969 – 1989
Hafer / Hein / MacDonald (1992)	3-month US-Treasury bill rate	Bond and Money Market Letter / Wall Street Journal	Quarterly and semi-annual	1977 – 1988
Zarnowitz / Braun (1992)	3-month US-Treasury bill rate	ASA-NBER Quarterly Survey	Quarterly	1968 – 1990
Cho (1996)	3-month US-Treasury bill rate and 30-year US-Government bond yield	Wall Street Journal	Semi-annual	1981 – 1994
Ilmanen (1996)	3-month US-Treasury bill rate and 30-year US-Government bond yield	Wall Street Journal	Semi-annual	1981 – 1994
Kolb / Stekler (1996)	3-month US-Treasury bill rate and 30-year US-Government bond yield	Wall Street Journal	Semi-annual	1982 – 1990
Gosnell / Kolb (1997)	3-month Euromarket rate for US, UK, Germany, Japan, Switzerland	Risk	Monthly	1990 – 1992
Baghestani / Jung / Zuchegno (2000)	3-month US-Treasury bill rate	ASA-NBER Quarterly Survey	Quarterly	1983 – 1995
Albrecht (2000)	3-month German money market rate and 10-year German Government bond yield	Finanzen	Monthly	1991 – 1997
Spiwoks (2003)	10-year German Government bond yield	Consensus Forecasts	Monthly	1989 – 1999
Greer (2003)	30-year US-Government bond yield	Wall Street Journal	Semi-annual	1984 – 1998
Brooks / Gray (2004)	30-year and 10-year US-Government bond yield	Wall Street Journal	Semi-annual	1982 – 2002
Mose (2005)	10-year US and German Government bond yield	Consensus Forecasts	Monthly	1989 – 2005
Baghestani (2005)	3-month US-Treasury bill rate	Survey of Professional Forecasters (SPF)	Quarterly	2001 – 2003
Scheier / Spiwoks (2006)	10-year U.K. Government bond yield	Consensus Forecasts	Monthly	1989 – 2003
Benke (2006)	10-year German Government bond yield	Handelsblatt	Annual	1991 – 2005
Spiwoks / Hein (2007)	10-year Government bond yield for US, UK, Germany, France, Italy, Japan	ZEW-Finanzmarktreport	Monthly	1995 – 2004

Domian (1992) argues that money market mutual funds which are able to forecast interest rates should lengthen their maturities before a drop in rates, and shorten their maturities before a rise in rates. An examination of the maturity structures of the reviewed funds shows that the fund managers were not able to predict the future movements of interest rates. In a similar study, Francis (1991) examines commercial bank exposure positions. The intuition is that the management of exposure to interest rate risk reveals the banks' implicit forecast of interest rates. It emerges that changes in the exposure position are unrelated to later changes of the interest rate level. Zarnowitz and Braun (1992) establish that the analyzed interest rate forecasts were superior to an ARIMA model. In the study carried out by Ilmanen (1996), the quality of the interest rate forecasts was poorer than that of naïve forecasts. Cho (1996), on the other hand, consideres that most of the analyzed forecast time series were better than naïve forecasts. Kolb and Stekler (1996) show that interest rate forecasts by market experts were not significantly better than random walk forecasts. Baghestani, Woo and Zuchegno (2000) establish that the interest rate forecasts they looked at were usually less accurate than the futures market. Greer (2003) concludes that the reviewed analysts' estimates have a better forecast quality than the random walk forecast. The results obtained by Brooks and Gray (2004) and Mose (2005) were exactly the opposite. Baghestani (2005) finds that, depending on the forecast horizon and the applied forecast error measure, sometimes the naïve forecast and sometimes the analysts' forecast provide better results.

Forecasts of US interest rates are not the only ones which have been investigated. Gosnell and Kolb (1997) as well as Spiwoks and Hein (2007) analyze interest rate forecasts for the US, Japanese, British, German, French, Italian and Swiss money and capital markets. Whereas Gosnell and Kolb's results reveal that the survey forecasts were usually more successful than naïve forecasts, Spiwoks and Hein come to the opposite conclusion.

Albrecht (2000), Spiwoks (2003), Mose (2005) and Benke (2006) show that German banks predict the future time path of interest rates less correctly than corresponding naïve forecasts. Scheier and Spiwoks (2006) come to the conclusion that apart from a few exceptional cases, interest rate forecasts for the British bond market are of a lower quality than naïve forecasts.

There are thus more than a dozen studies on US interest rate forecasts, but there is still a need for further research in this field. This is largely due to four aspects:

1. The observation of the success of capital market forecasts is a continuous task, given that considerable changes can result due to changing market conditions as well as the further development of analysis methods. More than half of the previous studies of US interest rate forecasts are based on forecast data from before 1990. The extent to which these studies reflect the circumstances of the more recent past is questionable.

2. Many of the studies available restricted themselves to only one or two investigation methods, so that a complete picture is not provided. The TOTA coefficient in particular has never been used on US forecast time series until now. The modified Diebold-Mariano test for forecast encompassing with four fundamental benchmarks has also not been comprehensively used as yet.

3. In most of the studies the data basis is rather small, because either only annual, semi-annual or quarterly data were evaluated, or because the period of time reviewed is relatively short.

4. The survey results are usually summarized to consensus forecasts, so that only a single forecast time series can be analyzed for each subject of a forecast. There has thus been no differentiated analysis of the forecasting success of the individual survey participants. Differentiated analyses of this type do however exist for forecasts of German (Albrecht, 2000; Spiwoks, 2003; Benke, 2006) and British (Scheier and Spiwoks, 2006) interest rate trends. They not only give an impression of the average forecasting success; they also reveal possible differences between the institutions making the forecasts. Until now, only Kolb and Stekler (1996) and Cho (1996) have presented studies on US interest rate forecasts which break down the results into those of the individual forecasters. However, Kolb and Stekler (1996) only studied the work of eleven forecasters, and the forecast time series they analyzed only have nine values on average. Cho (1996) at least covers 24 different forecasters, though the forecast time series are also fairly short. They have a maximum of 26 values. In addition, he only employs a very narrow repertoire of procedures to measure the quality of forecasts.

In this study, we analyzed 136 forecast time series for 10-year US-Government bond yields and 3-month US-Treasury bill rates from 34 banks, insurance companies and

other financial services companies, research and consulting institutes, associations and industrial companies. The shortest examined time series is 50 forecast data, the longest 171 forecast data. On average each of the 136 time series provides 101 forecast data. With a total of 13,798 items of forecast data, it is by far the most extensive study on US interest rate forecasts yet carried out. The use of a total of eight procedures to evaluate forecasts permits a differentiated assessment of the performance of US bond market analysts.

The enormous practical significance of interest rate forecasts, particularly for the credit services sector and the investment business, justifies every effort made to examine their reliability in as comprehensive, differentiated and up-to-date way as possible.

The evaluation of the forecast time series is carried out in Chapter 4. The underlying methods are presented in the next chapter, while the data base is defined in the chapter after next. A summary of the research results as well as the conclusion follows in Chapter 5.

2 Methods

The forecast data is examined with regard to unbiasedness, efficiency and sign accuracy. With the aid of the modified Diebold-Mariano test for forecast encompassing, the quality of the forecast is compared to four different benchmarks (naïve forecasts, ARIMA models, implicit forward rates, consensus forecasts). Finally, the TOTA coefficient is used to help identify topically orientated trend adjustment behavior.

The test for unbiasedness examines whether the forecasts correspond to the actual events which take place later on. x_t represents the actual event at the moment in time t, $\hat{x}_t$ represents the forecast of this event, and u_t a residual at the moment in time t.

$$x_t = a + b\,\hat{x}_t + u_t \tag{1}$$

If this relationship is created between the forecast data and corresponding actual events, the following picture arises: It can be stated that the forecasts are unbiased if a does not significantly differ from 0 and b does not significantly differ from 1, and in addition if the error term u is not autocorrelated. The former is verified with the aid of

the F-test and the latter by using the Durbin-Watson test. All standard errors are calculated applying the Newey and West (1987) estimation procedure that allows for heteroscedasticity in the error terms. This is indispensably when the forecast horizon is larger than the observational frequency (see Hanson and Hodrick, 1980).

The test for efficiency examines whether appropriate consideration has been given to the actual events which can be observed before the issue of a forecast. x_t represents the actual event at the moment in time t, $\hat{x}_t$ represents the forecast of this event, h the forecast horizon and u_t a residual at the moment in time t.

$$x_t - \hat{x}_t = b_0 + \sum_{i=1}^{4} b_i \, x_{t-h-i} + u_t \tag{2}$$

If the available information has been used efficiently, the analysts' forecast errors should not be correlated with the lags. Following the example of Simon (1989), we take the last four actual events into consideration. Whether an existing correlation between the forecast errors and the lag variables can be viewed as significant is determined with the aid of the F-test.

Sign accuracy is measured by comparing the forecasts with the actual events and then arranging them in a 2x2 contingency table.

Table 2 2x2 contingency table

	Actual event: interest rates rise	Actual event: interest rates fall	Σ
Forecast: interest rates rise	N_{11}	N_{12}	$N_{1.}$
Forecast: interest rates fall	N_{21}	N_{22}	$N_{2.}$
Σ	$N_{.1}$	$N_{.2}$	N

The forecasts which estimated the direction of development of interest rates correctly (rising or falling) can be found in the main diagonals (N_{11} and N_{22}). The off-diagonals

(N_{12} and N_{21}) contain the forecasts which wrongly estimated the direction of the interest rate change. An χ^2 test is now applied to examine whether the distribution frequency of the four fields is significantly different from a random walk forecast (cf. Diebold and Lopez, 1996; Joutz and Stekler, 2000). If this is the case, it is necessary to determine whether the forecasts examined were significantly better or significantly worse than a random walk forecast.

In addition, the forecasts should be measured against various benchmarks. Fair and Shiller (1990) show that the measurement of forecast accuracy on the basis of root mean squared error (RMSE) or Theil's U_2 do not permit reliable deductions about the information content of a forecast time series. The modified Diebold-Mariano test for forecast encompassing is therefore applied here to examine whether the analyzed forecast time series have a level of information content which goes significantly beyond the benchmark forecast. The initial premise here is that a forecasted situation y_m is described by two competing forecast models *i* and *j*:

$$\hat{y}_m = (1-\lambda)\,\hat{y}_{i,m} + \lambda\,\hat{y}_{j,m} \tag{3}$$

where $0 \leq \lambda \leq 1$. If $\lambda = 0$, then the forecasts generated by model *i* are said to encompass the forecasts generated by model *j*, as model *j* does not contribute any useful information – apart from that already contained in model *i* – to the formation of an optimal composite forecast. Harvey, Leybourne and Newbold (1998) develop a statistic to test the null hypothesis that $H_0 : \lambda = 0$ against the alternative that $H_1 : \lambda > 0$. If the null hypothesis is rejected, then the forecasts contain distinct predictive information which is useful in forming the optimal forecast $\hat{y}_m$.

Four different benchmarks are employed to contribute to a comprehensive evaluation of the success of the forecast: 1. the (no change) naïve forecast, 2. a simple ARIMA model, 3. the rate expectations of the capital market in the form of implicit forward rates and 4. the average rate expectations of capital market analysts (consensus forecasts).

The appropriateness of the ARIMA models was determined with the aid of the AIC criterion. The ARIMA model for the 10-year US-Government bond yield contains two autoregressive terms, the consideration of the first differences and two moving aver-

age terms. The ARIMA model for the 3-month US-Government bond yield contains six autoregressive terms, the consideration of the first differences and six moving average terms.

The calculation of the implicit forward rates is based on the market expectations hypothesis. This hypothesis suggests that the shape of the yield curve depends on market participants' expectations of future interest rates. The calculation of the implicit forward rates is carried out as follows:

$$i_{gk} = \sqrt[k-g]{\frac{(1+i_{0k})^k}{(1+i_{0g})^g}} - 1 \tag{4}$$

where i_{gk} represents the implicit forward rate of the maturity $k-g$, i_{0k} represents the current interest rate for the longer maturity k and i_{0g} represents the current interest rate for the shorter maturity g.

When forecasts are mainly shaped by the current trend of the variable to be forecast, so that the forecasts correspond to a greater extent with actual events at the time when forecasts were issued than with those at their respective point of time of validity, this is labeled as topically orientated trend adjustment behavior of forecasts (TOTA).

Financial market forecasts which are continually adjusted to current market movements may, in the worst case, completely lose their future-oriented character. Therefore it is of special interest whether a forecast is marked by topically orientated trend adjustment behavior. The TOTA coefficient can be used to identify this characteristic. The TOTA coefficient shows whether the forecast data time series reflects the actual market movements or whether the forecast data time series rather reflects the time series of naïve forecasts. With help of the TOTA coefficient one can recognize whether the forecaster orients his forecasts towards the future or to the present market situation.

To calculate the TOTA coefficient (see Bofinger and Schmidt, 2003; Andres and Spiwoks, 1999), firstly the coefficient of determination of the forecast data and the actual events are calculated (R^2_A; Figure 1). Then the coefficient of determination of the forecast data from the time when forecasts were issued with the actual events is calculated (R^2_B; Figure 2).

$$\text{TOTA coefficient} = \frac{R_A^2}{R_B^2} = \frac{R^2_{\text{forecasts; actual}}}{R^2_{\text{forecasts; actual - } h}} \tag{5}$$

With h: Forecast horizon

If the value of the TOTA coefficient is < 1, a topically orientated trend adjustment must be assumed. In this case the forecast time series transferred back to the time when forecasts were issued shows a higher correspondence with the actual values than the forecast time series did at the time of its validity. For a TOTA coefficient < 1, the forecast time series reflects the present more strongly than the future. As an introduction to TOTA coefficient, some forecast time series are graphically analyzed to simplify an intuitive understanding of the character of forecast time series.

3 Data

Bates and Granger (1969) were the first to ask whether better forecast results could be achieved through the combination of forecasts. This is based on the idea that each of the existing forecasts contains useful information on future events, and that these sets of information could be merged by combining the forecasts. This theory initiated a lively scientific discussion about the possibilities and limits of combined forecasts, which culminated in 1989 with special editions of both the Journal of Forecasting and the International Journal of Forecasting. Against the background of this trenchant discussion, the company Consensus Economics founded the Consensus Forecasts Magazine. It has been published monthly since October 1989. In each economy reviewed, local financial service companies, research institutions and industrial companies deliver the forecast data for their countries to Consensus Economics. Forecasts are made for important economic values. The consensus forecasts are made by a simple average of the base forecasts included. In this way Consensus Economics produces, among others, forecasts of interest rates. Not only the mean, but also the single forecasts of the companies and institutions involved are published. These data are the basis of this study.

Forecasts of the ten-year US-Government bond yield and forecasts of three-month US-Treasury bill rates are evaluated. Consensus Forecasts distinguishes between two forecast horizons: three and twelve months. In practical terms, however, the forecast horizons are of four and 13 months. This can be clarified by an example: In the Consensus Forecasts Magazine of September 2001, which comes out in the middle of the month, forecasts for the end of December 2001 and for the end of September 2002 are published. The published forecasts were compiled at the beginning of September at the participating institutions. From the beginning of September to the end of December is actually four months, and from the beginning of September of the year in question to the end of September of the following year is actually 13 months. This supposedly unimportant detail plays a significant role when it comes to setting a fair criterion for the forecasts.

Here, all companies are examined which delivered at least 50 interest rate forecasts to Consensus Forecasts. This applied to 34 companies in total, among which were banks, insurance companies, and other financial services companies like U. S. Trust, Northern Trust, Merrill Lynch, Credit Suisse First Boston, J. P. Morgan, Chase Manhattan, Smith Barney, Wells Fargo, Chemical Bank, Continental Bank, Core States Financial Corp. / First Union / Wachovia, Mortgage Bankers, Fannie Mae, Metropolitan Life and Prudential Insurance. Also included are research and consultancy institutes as well as associations like Interindustry Forecasting at the University of Maryland (Inforum), Research Seminar in Quantitative Economics at the University of Michigan (RSQE), Georgia State University, Oxford Economic Forecasting (OEF), Wharton Econometric Forecasting Associates (WEFA), Conference Board, Standard & Poor's, Regional Financial Association / Economy.com, Consensus Economics, Dun & Bradstreet, Griggs & Santow, National Association of Homebuilders, and National Association of Manufacturers. Major industrial companies such as General Motors, Ford Motors, Daimler / Chrysler, Amoco, DuPont, and Eaton Corp. also appear as market experts.

The period of time researched is October 1989 to December 2004. The 136 forecast time series contain 13,798 items of data. The shortest examined time series is 50 forecast data, the longest 171 forecast data. On average each of the 136 time series provides 101 forecast data. This initial situation demands restraint in the comparison of the forecasting results of individual institutes, because it cannot be ruled out that the

interest rate trend is simpler to forecast during some periods and more difficult in others. So if some institutes have only made forecasts in 50, 60 or 70 of the total of 171 months which were analyzed, it is conceivable that the respective specific period for which the forecast is made is decisive for its success or failure. A ranking of institutes according to their forecasting success would only be permissible if all the institutes had participated in the survey during the entire observation period. In spite of this, it is still meaningful to evaluate the forecasting data according to institutes, as in this way we can recognize which characteristics of the interest rate forecasts only refer to a part of the forecast time series and which characteristics occur generally. This also possibly offers points of departure for an improvement of the forecasting procedures employed.

In addition, the data basis also reveals the problem that there are individual items of data missing in some forecast time series. This is a particular impediment for the use of the Durbin-Watson test as part of the unbiasedness test. Following on from the example of Simon (1989), this study does not employ correction procedures. Savin and White (1978) have shown that this is wholly justified. With regard to additional procedures for measuring the quality of forecasts, Lim and McKenzie (1998) established that "ignoring the missing observations leads to the same qualitative outcome as correctly taking account of the missing observations". A similar opinion represents Zarnowitz (1984).

4 Empirical results

Determining whether the forecasts are unbiased leads to a critical appreciation of the success of the forecasts. The F-test thus already reveals that – without exception – all the forecast time series with a forecast horizon of 13 months are biased (Table 3 and Table 5). For the forecasts of the 10-year US-Government bond yield with a forecast horizon of four months, the F-test reveals bias in 28 out of 34 cases (Table 4). For the forecasts of the 3-month US-Treasury bill rate with a forecast horizon of four months, the F-test still shows a bias in 20 out of 34 cases (Table 6). The results of the Durbin-Watson test are even clearer. In all 136 forecast time series there is a clear autocorrelation of the residuals u_t (Tables 3-6). How these autocorrelations arise is explained in detail later on in the examination of the TOTA coefficient.

The connection postulated in equation (1) between forecasts and actual events where $E(a) = 0$, where $E(b) = 1$ and where u_t are randomly distributed residuals, obviously does not correspond to the actual reality of the analyzed forecast time series.

The efficiency tests provide a very mixed picture. In the forecasts of the 10-year US-Government bond yield with a forecast horizon of 13 months, the forecasting error reveals a significant correlation with actual events in the past in 25 out of 34 forecast time series (Table 7). The information available in the actual development of interest rates has therefore not been appropriately taken into consideration in the forecasts in 25 out of 34 cases. The picture becomes more favorable in the case of forecasts with a horizon of only four months (Table 8). An inefficient evaluation of information is only revealed in 16 out of 34 forecast time series. The forecasts for the 3-month US-Treasury bill rate with a forecast horizon of 13 months reveal significant inefficiencies in 28 out of 34 cases (Table 9). In the corresponding forecasts with a horizon of four months 27 out of 34 cases indicate a significantly inefficient use of values from the past (Table 10).

Table 3 Results of unbiasedness test of 10-year US-Government bond yield forecasts with 13 months forecast horizon

Institution	α	st. dev.	β	st. dev.	F-Dist.	crit. v.	DW	crit. v.
Consensus Forec.	1.107	1.072	0.743	0.154	36.964	3.050	0.132	1.65
Amoco Corp.	4.312	1.434	0.348	0.215	23.491	3.105	0.207	1.62
Chase Manhattan	5.136	1.738	0.239	0.244	33.916	3.143	0.194	1.58
Chemical Bank	6.435	1.909	0.046	0.277	34.934	3.134	0.143	1.58
Conference B.	2.329	1.230	0.493	0.166	68.311	3.086	0.186	1.65
Continental Bk.	5.564	1.748	0.192	0.233	34.593	3.168	0.145	1.53
Core/FU/Wacho.	2.187	1.414	0.579	0.204	37.755	3.059	0.180	1.65
CSFB	2.297	1.185	0.596	0.178	17.758	3.087	0.262	1.65
Daimler/Chrysler	1.674	1.463	0.599	0.213	53.922	3.085	0.169	1.65
Dun & Bradstreet	7.763	1.715	-0.176	0.230	112.670	3.138	0.201	1.57
DuPont	2.218	1.353	0.549	0.201	28.429	3.065	0.143	1.65
Eaton Corp.	2.797	1.097	0.457	0.154	46.041	3.064	0.139	1.65
Fannie Mae	1.360	1.449	0.698	0.234	8.999	3.109	0.194	1.62
Ford Motors	0.719	1.254	0.791	0.181	43.960	3.054	0.201	1.65
General Motors	0.745	0.900	0.779	0.129	43.095	3.068	0.374	1.65
Georgia State Un.	2.868	0.626	0.351	0.133	16.581	3.259	0.193	1.50
Griggs & Santow	3.088	1.152	0.458	0.157	80.970	3.076	0.179	1.65
Inforum	2.712	0.892	0.405	0.128	18.735	3.136	0.174	1.57
J. P. Morgan	2.209	0.839	0.528	0.120	42.704	3.086	0.205	1.65
Merrill Lynch	3.462	1.637	0.427	0.222	37.884	3.101	0.209	1.64
Metropolitan Life	5.748	2.502	0.138	0.361	27.292	3.104	0.120	1.62
Mortage Bankers	3.013	1.352	0.220	0.272	36.557	3.739	0.109	1.57
N. A. Homebuild.	3.883	1.170	0.252	0.173	49.871	3.092	0.159	1.65
N. A. Manufact.	5.306	1.932	0.213	0.284	29.639	3.126	0.133	1.58
Northern Trust	1.448	0.803	0.695	0.105	41.415	3.078	0.294	1.65
OEF	1.963	0.833	0.553	0.153	21.123	3.132	0.257	1.60
Prudential Ins.	6.835	2.215	-0.208	0.369	31.125	3.085	0.093	1.65
Regional Fin. A.	1.788	1.120	0.577	0.161	70.100	3.080	0.175	1.65
RSQE	3.207	0.986	0.337	0.161	41.852	3.109	0.163	1.62
Smith Barney	3.568	1.974	0.448	0.282	16.037	3.108	0.237	1.61
Standard&Poor's	3.500	1.308	0.384	0.182	49.818	3.071	0.178	1.65
US Trust	2.588	1.095	0.496	0.167	19.737	3.080	0.124	1.65
WEFA Group	6.343	1.251	-0.454	0.167	57.847	3.100	0.126	1.63
Wells Fargo	3.077	1.041	0.398	0.151	45.891	3.073	0.147	1.65

F-test critical value on 0.95 significance level; Durbin-Watson test critical value on 0.95 significance level.

Table 4 Results of unbiasedness test of 10-year US-Government bond yield forecasts with 4 months forecast horizon

Institution	α	st. dev.	β	st. dev.	F-Dist.	crit. v.	DW	crit. v.
Consensus Forec.	0.201	0.366	0.943	0.057	6.705	3.050	0.362	1.65
Amoco Corp.	0.313	0.680	0.809	0.964	3.876	3.105	0.352	1.62
Chase Manhattan	2.117	0.675	0.709	0.094	9.417	3.132	0.558	1.57
Chemical Bank	1.620	1.107	0.757	0.156	*0.762*	3.128	0.426	1.57
Conference B.	0.843	0.587	0.794	0.094	19.111	3.085	0.326	1.65
Continental Bk.	1.356	0.944	0.817	0.125	*2.946*	3.168	0.383	1.53
Core/FU/Wacho.	0.547	0.449	0.897	0.069	4.322	3.058	0.512	1.65
CSFB	0.812	0.280	0.862	0.046	7.472	3.077	0.633	1.65
Daimler/Chrysler	-0.088	0.622	0.966	0.103	*1.194*	3.085	0.499	1.65
Dun & Bradstreet	2.815	0.890	0.560	0.127	16.963	3.136	0.399	1.57
DuPont	0.950	0.459	0.811	0.079	9.960	3.065	0.391	1.65
Eaton Corp.	0.647	0.429	0.859	0.070	10.646	3.064	0.394	1.65
Fannie Mae	0.892	0.577	0.810	0.093	5.953	3.109	0.465	1.62
Ford Motors	0.173	0.413	0.950	0.066	3.898	3.053	0.407	1.65
General Motors	0.606	0.392	0.873	0.065	8.608	3.068	0.465	1.65
Georgia State Un.	0.469	0.499	0.872	0.087	3.754	3.187	0.845	1.50
Griggs & Santow	1.143	0.458	0.805	0.068	15.051	3.076	0.591	1.65
Inforum	0.854	0.580	0.798	0.113	5.627	3.136	0.537	1.57
J. P. Morgan	0.871	0.492	0.815	0.082	11.761	3.086	0.465	1.65
Merrill Lynch	1.242	0.565	0.801	0.081	8.091	3.097	0.427	1.63
Metropolitan Life	0.883	0.893	0.862	0.125	*2.202*	3.104	0.318	1.62
Mortage Bankers	1.070	0.783	0.771	0.158	*2.238*	3.232	0.514	1.55
N. A. Homebuild.	1.423	0.613	0.730	0.100	10.992	3.090	0.514	1.64
N. A. Manufact.	1.182	0.878	0.830	0.122	*2.298*	3.126	0.455	1.58
Northern Trust	0.289	0.412	0.929	0.063	5.499	3.077	0.674	1.65
OEF	1.127	0.553	0.756	0.105	6.724	3.128	0.402	1.60
Prudential Ins.	0.920	1.246	0.818	0.200	3.850	3.085	0.207	1.65
Regional Fin. A.	0.932	0.478	0.783	0.078	25.433	3.080	0.282	1.65
RSQE	1.388	0.437	0.714	0.083	15.349	3.109	0.466	1.62
Smith Barney	1.714	0.830	0.743	0.119	6.183	3.107	0.698	1.61
Standard&Poor's	0.928	0.492	0.828	0.082	10.110	3.071	0.580	1.65
US Trust	0.658	0.550	0.861	0.097	5.123	3.079	0.392	1.65
WEFA Group	2.653	0.729	0.559	0.110	15.186	3.084	0.334	1.63
Wells Fargo	1.349	0.432	0.729	0.070	19.282	3.073	0.414	1.65

F-test critical value on 0.95 significance level; Durbin-Watson test critical value on 0.95 significance level.

Table 5 Results of unbiasedness test of 3-month US-Treasury bill rate forecasts with 13 months forecast horizon

Institution	α	st. dev.	β	st. dev.	F-Dist.	crit. v.	DW	crit. v.
Consensus Forec.	0.660	0.962	0.687	0.170	44.841	3.049	0.049	1.65
Amoco Corp.	3.738	1.345	0.183	0.237	49.450	3.101	0.060	1.63
Chase Manhattan	3.512	1.170	0.207	0.179	68.064	3.138	0.069	1.58
Chemical Bank	4.069	1.341	0.134	0.232	37.140	3.138	0.058	1.58
Conference B.	0.567	1.038	0.695	0.173	29.137	3.087	0.068	1.65
Continental Bk.	3.149	1.153	0.247	0.179	52.248	3.165	0.062	1.53
Core/FU/Wacho.	1.258	1.029	0.569	0.178	52.380	3.055	0.073	1.65
CSFB	2.593	0.724	0.390	0.131	41.073	3.105	0.315	1.63
Daimler/Chrysler	-0.409	0.909	0.964	0.205	10.109	3.085	0.110	1.65
Dun & Bradstreet	4.440	1.395	0.008	0.264	40.134	3.140	0.034	1.57
DuPont	0.338	1.121	0.808	0.227	10.782	3.065	0.057	1.65
Eaton Corp.	0.530	1.053	0.724	0.184	23.464	3.064	0.071	1.65
Fannie Mae	0.867	1.377	0.639	0.293	11.284	3.111	0.049	1.62
Ford Motors	0.593	1.135	0.672	0.190	64.920	3.053	0.086	1.65
General Motors	1.106	1.294	0.603	0.213	32.888	3.065	0.119	1.65
Georgia State Un.	-0.534	0.725	1.030	0.148	4.060	3.195	0.344	1.53
Griggs & Santow	3.197	1.039	0.261	0.161	73.244	3.077	0.076	1.65
Inforum	-0.617	1.087	0.905	0.351	13.522	3.140	0.069	1.58
J. P. Morgan	0.351	0.729	0.726	0.131	31.998	3.088	0.113	1.65
Merrill Lynch	1.786	1.015	0.488	0.162	42.035	3.099	0.144	1.64
Metropolitan Life	3.329	1.549	0.252	0.269	34.590	3.108	0.056	1.62
Mortage Bankers	-0.180	0.885	0.943	0.128	3.666	3.162	0.315	1.57
N. A. Homebuild.	0.571	1.471	0.777	0.292	6.425	3.082	0.059	1.65
N. A. Manufact.	3.085	1.276	0.288	0.209	43.775	3.130	0.056	1.58
Northern Trust	1.277	0.685	0.547	0.105	74.137	3.080	0.126	1.65
OEF	0.088	0.942	0.746	0.275	15.206	3.126	0.076	1.60
Prudential Ins.	1.750	2.988	0.505	0.545	11.213	3.085	0.028	1.65
Regional Fin. A.	-0.186	1.093	0.812	0.197	33.908	3.079	0.063	1.65
RSQE	0.701	1.428	0.674	0.283	17.565	3.082	0.049	1.65
Smith Barney	3.511	1.105	0.239	0.188	44.569	3.109	0.093	1.61
Standard&Poor's	2.409	1.391	0.388	0.250	37.396	3.069	0.088	1.65
US Trust	0.460	0.892	0.825	0.203	4.247	3.077	0.063	1.65
WEFA Group	3.164	1.553	0.309	0.269	14.016	3.098	0.079	1.63
Wells Fargo	5.552	0.859	-0.077	0.145	128.070	3.120	0.141	1.60

F-test critical value on 0.95 significance level; Durbin-Watson test critical value on 0.95 significance level.

Table 6 Results of unbiasedness test of 3-month US-Treasury bill rate forecasts with 4 months forecast horizon

Institution	α	st. dev.	β	st. dev.	F-Dist.	crit. v.	DW	crit. v.
Consensus Forec.	-0.179	0.136	0.999	0.030	11.006	3.050	0.278	1.65
Amoco Corp.	0.142	0.325	0.944	0.064	4.096	3.101	0.308	1.57
Chase Manhattan	0.209	0.275	0.923	0.054	7.726	3.130	0.601	1.57
Chemical Bank	0.198	0.373	0.955	0.069	*0.555*	3.132	0.385	1.58
Conference B.	0.089	0.180	0.932	0.042	9.000	3.086	0.413	1.65
Continental Bk.	0.254	0.311	0.925	0.067	*2.461*	3.168	0.321	1.53
Core/FU/Wacho.	-0.114	0.171	0.988	0.038	7.665	3.056	0.440	1.65
CSFB	0.241	0.180	0.920	0.036	8.124	3.104	0.795	1.62
Daimler/Chrysler	-0.198	0.127	1.029	0.032	*1.878*	3.085	0.427	1.65
Dun & Bradstreet	0.520	0.314	0.871	0.067	*2.694*	3.143	0.338	1.57
DuPont	-0.040	0.151	0.988	0.038	*1.962*	3.065	0.304	1.65
Eaton Corp.	-0.106	0.168	0.977	0.037	7.913	3.063	0.409	1.65
Fannie Mae	-0.101	0.183	0.986	0.044	3.140	3.111	0.510	1.62
Ford Motors	-0.156	0.208	0.975	0.045	15.775	3.053	0.325	1.65
General Motors	-0.082	0.211	0.995	0.040	*2.051*	3.065	0.313	1.65
Georgia State Un.	-0.309	0.112	1.038	0.034	7.757	3.191	0.893	1.53
Griggs & Santow	0.403	0.327	0.890	0.059	9.467	3.077	0.370	1.65
Inforum	-0.451	0.145	1.049	0.056	8.330	3.140	0.412	1.58
J. P. Morgan	-0.055	0.133	0.964	0.030	10.700	3.087	0.662	1.65
Merrill Lynch	0.043	0.169	0.976	0.039	*1.044*	3.095	0.768	1.63
Metropolitan Life	0.060	0.335	0.965	0.067	*2.337*	3.109	0.348	1.62
Mortage Bankers	-0.155	0.095	1.019	0.031	*1.060*	3.140	0.925	1.55
N. A. Homebuild.	-0.063	0.176	1.009	0.037	*0.182*	3.082	0.423	1.65
N. A. Manufact.	0.191	0.349	0.953	0.068	*0.661*	3.132	0.330	1.58
Northern Trust	0.005	0.114	0.968	0.030	6.001	3.079	0.762	1.65
OEF	-0.124	0.131	0.980	0.046	4.998	3.126	0.464	1.60
Prudential Ins.	-0.749	0.525	1.131	0.106	4.569	3.085	0.352	1.65
Regional Fin. A.	-0.366	0.145	1.017	0.031	17.989	3.079	0.299	1.65
RSQE	-0.076	0.153	0.975	0.032	6.613	3.082	0.381	1.65
Smith Barney	0.342	0.237	0.904	0.050	9.067	3.111	0.876	1.61
Standard&Poor's	0.193	0.218	0.945	0.045	*2.495*	3.068	0.432	1.65
US Trust	-0.057	0.147	0.993	0.038	*1.715*	3.076	0.378	1.65
WEFA Group	-0.429	0.455	0.911	0.070	*1.826*	3.097	0.566	1.63
Wells Fargo	1.072	0.411	0.776	0.079	10.332	3.122	0.530	1.60

F-test critical value on 0.95 significance level; Durbin-Watson test critical value on 0.95 significance level.

Table 7 Results of TOTA coefficient, efficiency test and modified Diebold-Mariano test for forecast encompassing (naïve forecasts, ARIMA forecasts, implicit forward rates, mean expectations) of 10-year US-Government bond yield forecasts with 13 months forecast horizon

Institution	TOTA coef-ficient	Efficiency test		Modified Diebold-Mariano test				
		F-dist.	crit. v.	naïve f. t-dist.	ARIMA t-dist.	forw. r. t-dist.	expect. t-dist.	MDM crit. v.
Consensus Forec.	0.469	3.903	2.437	0.208	0.227	0.809	–	1.654
Amoco Corp.	0.170	9.746	2.489	*2.904*	*3.008*	*5.252*	*4.839*	1.663
Chase Manhattan	0.095	12.640	2.534	0.171	0.027	0.694	-0.451	1.669
Chemical Bank	0.000	3.273	2.520	0.502	0.529	0.707	-0.028	1.668
Conference B.	0.349	5.470	2.465	-0.134	-0.769	-0.469	-0.969	1.673
Continental Bk.	0.065	16.37	2.565	-0.709	-0.136	0.239	-1.376	1.660
Core/FU/Wacho.	0.390	2.852	2.437	-0.216	-0.146	0.039	-1.121	1.655
CSFB	0.406	5.782	2.469	1.178	1.212	*1.954*	1.617	1.660
Daimler/Chrysler	0.373	*1.585*	2.464	0.447	0.439	0.246	0.166	1.660
Dun & Bradstreet	0.137	49.090	2.520	-0.433	-0.443	-0.806	-1.231	1.668
DuPont	0.234	*2.039*	2.442	0.069	0.089	-0.307	-0.111	1.656
Eaton Corp.	0.243	7.498	2.441	-0.930	-0.966	-0.496	-0.424	1.656
Fannie Mae	0.266	*1.551*	2.489	0.661	0.659	0.617	*2.636*	1.664
Ford Motors	0.497	*1.337*	2.432	0.703	0.729	0.739	-0.129	1.655
General Motors	0.616	*2.091*	2.447	-0.245	-0.233	0.209	-0.784	1.657
Georgia State Un.	0.219	*0.669*	2.659	-0.352	-0.026	-0.960	-1.239	1.694
Griggs & Santow	0.346	24.100	2.455	-0.967	-0.976	-1.034	-1.673	1.658
Inforum	0.103	*0.659*	2.518	0.611	0.612	0.454	1.276	1.668
J. P. Morgan	0.368	3.945	2.465	-1.061	-1.032	-1.993	-1.481	1.660
Merrill Lynch	0.299	7.960	2.484	-0.805	-0.803	-0.594	-1.538	1.662
Metropolitan Life	0.001	4.141	2.487	1.092	1.107	*2.024*	0.940	1.663
Mortage Bankers	0.183	*2.361*	3.357	-0.691	-0.672	-0.511	0.165	1.753
N. A. Homebuild.	0.107	3.673	2.471	-1.420	-1.344	-1.650	-1.233	1.661
N. A. Manufact.	0.040	11.341	2.513	0.703	0.693	1.143	0.675	1.666
Northern Trust	0.586	5.849	2.458	-0.552	-0.324	0.339	0.622	1.659
OEF	0.452	6.084	2.513	1.344	1.332	1.281	1.378	1.667
Prudential Ins.	0.067	*1.570*	2.464	0.474	0.445	0.609	0.570	1.660
Regional Fin. A.	0.405	4.854	2.457	-0.144	-0.153	-0.155	-0.972	1.659
RSQE	0.205	5.714	2.489	-1.209	-1.072	-0.627	0.030	1.664
Smith Barney	0.266	6.936	2.492	*3.006*	*2.884*	*3.455*	*2.281*	1.663
Standard&Poor's	0.199	8.891	2.448	-1.198	-1.215	-0.437	-0.066	1.657
US Trust	0.239	3.402	2.457	0.355	0.354	0.298	1.122	1.659
WEFA Group	0.004	9.472	2.479	-0.217	-0.193	0.088	-1.057	1.662
Wells Fargo	0.214	4.959	2.479	-0.758	-0.765	-1.693	-1.669	1.658

Efficiency F-test critical value on 0.95 significance level; modified Diebold-Mariano test critical value on 0.95 significance level.

Table 8 Results of TOTA coefficient, efficiency test and modified Diebold-Mariano test for forecast encompassing (naïve forecasts, ARIMA forecasts, implicit forward rates, mean expectations) of 10-year US-Government bond yield forecasts with 4 months forecast horizon

Institution	TOTA coef-ficient	Efficiency test		Modified Diebold-Mariano test				
		F-dist.	crit. v.	naïve f. t-dist.	ARIMA t-dist.	forw. r. t-dist.	expect. t-dist.	MDM crit. v.
Consensus Forec.	0.832	*1.811*	2.427	-0.661	-0.354	0.040	–	1.654
Amoco Corp.	0.705	*1.896*	2.489	-1.027	-0.806	-0.390	-1.490	1.663
Chase Manhattan	0.693	4.348	2.520	-0.273	-0.076	0.151	-0.541	1.667
Chemical Bank	0.492	*0.645*	2.513	-2.321	-2.077	-1.968	-1.829	1.667
Conference B.	0.723	4.071	2.464	-0.992	-1.047	-1.295	-1.953	1.660
Continental Bk.	0.755	2.827	2.565	1.503	1.490	1.598	1.340	1.673
Core/FU/Wacho.	0.817	*1.246*	2.426	0.186	0.407	0.594	0.604	1.655
CSFB	0.898	5.426	2.457	*2.137*	*2.613*	*2.629*	*3.437*	1.658
Daimler/Chrysler	0.817	*1.631*	2.464	0.389	0.476	0.224	0.966	1.660
Dun & Bradstreet	0.430	6.264	2.518	-0.303	0.014	-0.024	0.565	1.668
DuPont	0.732	3.079	2.442	-0.478	-0.398	-0.035	1.067	1.656
Eaton Corp.	0.760	*2.337*	2.441	-0.446	-0.146	-0.198	1.244	1.656
Fannie Mae	0.649	*2.375*	2.489	-0.095	-0.158	-0.225	0.149	1.664
Ford Motors	0.845	3.349	2.431	-0.253	-0.207	0.295	-0.485	1.654
General Motors	0.850	4.053	2.447	-1.029	-1.255	-0.902	-1.008	1.657
Georgia State Un.	0.767	*0.909*	2.574	-0.823	-0.629	-1.009	-1.477	1.674
Griggs & Santow	0.802	6.543	2.455	0.434	0.784	0.867	1.575	1.658
Inforum	0.672	*2.145*	2.518	0.380	0.395	0.479	0.384	1.668
J. P. Morgan	0.761	2.530	2.465	0.081	0.038	-0.266	0.714	1.660
Merrill Lynch	0.799	*2.479*	5.821	-0.305	-0.526	-0.192	-0.333	1.662
Metropolitan Life	0.645	*0.975*	2.487	0.448	0.669	1.149	0.933	1.663
Mortage Bankers	0.709	*1.139*	2.626	-0.705	-0.537	-0.679	-0.325	1.683
N. A. Homebuild.	0.724	3.437	2.469	-0.626	-0.355	-0.531	0.346	1.661
N. A. Manufact.	0.684	*1.430*	2.513	0.712	0.884	1.211	1.253	1.666
Northern Trust	0.845	*0.671*	2.457	-1.020	-0.469	-0.032	0.601	1.658
OEF	0.701	*1.633*	2.513	0.673	0.830	1.032	1.086	1.667
Prudential Ins.	0.499	4.560	2.463	-0.190	-0.220	-0.278	0.326	1.660
Regional Fin. A.	0.747	5.199	2.457	-1.357	-1.422	-1.519	-2.374	1.659
RSQE	0.779	3.957	2.489	-0.077	0.088	0.279	0.299	1.664
Smith Barney	0.645	*1.038*	2.490	0.273	0.492	0.836	0.999	1.663
Standard&Poor's	0.770	*2.028*	2.448	-1.554	-1.043	-0.863	-0.318	1.657
US Trust	0.719	*2.048*	2.457	-0.351	-0.285	-0.421	1.203	1.659
WEFA Group	0.437	4.311	2.462	-1.313	-1.436	-0.975	-1.304	1.659
Wells Fargo	0.688	4.086	2.451	-3.423	-3.178	-3.560	-2.030	1.658

Efficiency F-test critical value on 0.95 significance level; modified Diebold-Mariano test critical value on 0.95 significance level.

Table 9 Results of TOTA coefficient, efficiency test and modified Diebold-Mariano test for forecast encompassing (naïve forecasts, ARIMA forecasts, implicit forward rates, mean expectations) of 3-month US-Treasury bill rate forecasts with 13 months forecast horizon

Institution	TOTA coef-ficient	Efficiency test		Modified Diebold-Mariano test				
		F-dist.	crit. v.	naïve f. t-dist.	ARIMA t-dist.	forw. r. t-dist.	expect. t-dist.	MDM crit. v.
Consensus Forec.	0.429	12.790	2.427	-0.223	1.189	*2.168*	–	1.654
Amoco Corp.	0.113	21.280	2.484	0.637	1.463	*2.665*	1.545	1.662
Chase Manhattan	0.168	19.960	2.528	-0.106	0.495	*2.457*	-1.065	1.668
Chemical Bank	0.066	17.620	2.528	0.917	1.383	*1.704*	0.290	1.668
Conference B.	0.483	5.760	2.465	-0.558	-0.211	-0.686	-1.097	1.660
Continental Bk.	0.231	45.560	2.561	-0.211	0.643	*1.766*	-0.681	1.673
Core/FU/Wacho.	0.416	11.360	2.433	0.256	1.219	*2.520*	0.192	1.655
CSFB	0.340	20.940	2.489	0.887	*2.019*	*2.143*	1.336	1.663
Daimler/Chrysler	0.596	*1.941*	2.464	0.196	1.071	*2.558*	*2.179*	1.660
Dun & Bradstreet	0.014	17.370	2.523	-0.496	0.116	*1.756*	-0.654	1.669
DuPont	0.444	5.142	2.442	0.391	1.483	*1.863*	0.803	1.656
Eaton Corp.	0.435	7.803	2.441	-0.174	0.800	1.166	0.292	1.656
Fannie Mae	0.271	4.853	2.490	-0.424	0.560	-0.027	-0.930	1.664
Ford Motors	0.443	12.740	2.432	0.043	0.735	0.982	-0.496	1.655
General Motors	0.378	14.340	2.444	-0.916	0.054	0.980	-0.927	1.656
Georgia State Un.	0.841	*1.097*	2.584	-0.338	-0.408	*2.180*	0.942	1.677
Griggs & Santow	0.159	33.030	2.456	-1.067	0.172	*2.836*	-1.070	1.658
Inforum	0.456	*2.439*	2.523	0.211	0.862	1.239	1.323	1.669
J. P. Morgan	0.624	2.876	2.466	0.489	1.164	0.116	0.570	1.660
Merrill Lynch	0.429	14.430	2.482	0.168	1.374	*2.376*	0.881	1.662
Metropolitan Life	0.134	14.510	2.492	1.213	1.655	*2.135*	1.399	1.663
Mortage Bankers	0.583	*0.799*	2.546	-1.081	-0.825	0.802	-0.174	1.672
N. A. Homebuild.	0.412	*1.425*	2.460	-0.589	0.534	0.752	-0.519	1.659
N. A. Manufact.	0.223	23.960	2.518	0.715	1.650	*2.517*	*1.699*	1.667
Northern Trust	0.572	20.110	2.460	-0.495	0.604	*2.221*	-0.489	1.659
OEF	0.415	*2.267*	2.507	-0.668	0.437	0.652	0.995	1.666
Prudential Ins.	0.124	4.763	2.464	-0.491	0.077	0.348	-0.418	1.660
Regional Fin. A.	0.453	4.068	2.457	-1.516	-1.235	-0.589	-1.885	1.659
RSQE	0.355	2.658	2.460	-1.380	-0.205	-0.131	-1.679	1.659
Smith Barney	0.189	20.780	2.492	1.255	*1.791*	*2.870*	*2.101*	1.664
Standard&Poor's	0.267	12.300	2.446	0.024	1.255	*2.373*	0.627	1.657
US Trust	0.542	2.635	2.454	1.034	1.503	*2.584*	*2.042*	1.658
WEFA Group	0.104	4.998	2.476	0.134	1.059	*2.161*	-0.006	1.662
Wells Fargo	0.001	12.790	2.501	0.366	0.731	-0.002	-1.697	1.665

Efficiency F-test critical value on 0.95 significance level; modified Diebold-Mariano test critical value on 0.95 significance level.

Table 10 Results of TOTA coefficient, efficiency test and modified Diebold-Mariano test for forecast encompassing (naïve forecasts, ARIMA forecasts, implicit forward rates, mean expectations) of 3-month US-Treasury bill rate forecasts with 4 months forecast horizon

Institution	TOTA coef-ficient	Efficiency test		Modified Diebold-Mariano test				
		F-dist.	crit. v.	naïve f. t-dist.	ARIMA t-dist.	forw. r. t-dist.	expect. t-dist.	MDM crit. v.
Consensus Forec.	0.935	6.171	2.427	*3.340*	*4.526*	*7.246*	–	1.654
Amoco Corp.	0.889	6.477	2.484	*1.991*	*3.571*	*5.103*	-0.813	1.662
Chase Manhattan	0.921	*2.282*	2.518	*1.919*	*2.933*	*4.522*	0.400	1.667
Chemical Bank	0.889	2.857	2.520	*1.682*	*3.391*	*4.199*	-1.062	1.667
Conference B.	0.922	6.930	2.465	0.485	*1.821*	*4.933*	-0.987	1.660
Continental Bk.	0.909	3.700	2.565	*2.599*	*3.450*	*4.179*	-0.666	1.673
Core/FU/Wacho.	0.931	3.258	2.434	*3.203*	*3.801*	*7.340*	*1.850*	1.655
CSFB	0.936	3.529	2.487	*2.066*	*3.466*	*5.277*	0.764	1.663
Daimler/Chrysler	0.950	6.182	2.464	*2.578*	*3.547*	*6.937*	*1.888*	1.660
Dun & Bradstreet	0.800	3.948	2.525	*2.894*	*4.231*	*3.932*	0.694	1.669
DuPont	0.918	4.823	2.442	*2.383*	*4.176*	*7.185*	-0.916	1.656
Eaton Corp.	0.904	13.530	2.440	0.425	*2.930*	*5.527*	-2.722	1.656
Fannie Mae	0.912	5.913	2.490	1.367	*2.958*	*6.233*	-0.327	1.664
Ford Motors	0.934	2.651	2.430	1.618	*3.620*	*4.711*	-1.703	1.654
General Motors	0.933	15.842	2.444	1.616	*2.984*	*6.219*	-0.639	1.656
Georgia State Un.	0.987	*1.059*	2.579	-1.580	1.661	*3.665*	-0.858	1.677
Griggs & Santow	0.867	10.080	2.456	*1.690*	*3.210*	*7.052*	-0.120	1.658
Inforum	0.936	3.683	2.523	1.472	*1.979*	*4.258*	0.373	1.669
J. P. Morgan	0.954	*1.491*	2.465	*2.434*	*2.789*	*5.211*	*2.015*	1.660
Merrill Lynch	0.940	*2.454*	2.478	*3.016*	*4.006*	*4.734*	*3.060*	1.661
Metropolitan Life	0.893	2.853	2.494	*2.370*	*3.911*	*4.516*	-0.870	1.664
Mortage Bankers	0.953	2.725	2.523	1.430	*1.990*	*6.922*	1.239	1.669
N. A. Homebuild.	0.945	3.709	2.460	*2.496*	*3.206*	*6.980*	1.515	1.659
N. A. Manufact.	0.892	4.199	2.520	*2.535*	*3.886*	*4.908*	-0.350	1.667
Northern Trust	0.970	3.901	2.459	*3.247*	*4.477*	*5.624*	*1.838*	1.659
OEF	0.937	*2.082*	2.507	*1.998*	*2.176*	*5.772*	1.380	1.666
Prudential Ins.	0.848	7.998	2.463	1.175	*2.696*	*4.950*	-1.163	1.660
Regional Fin. A.	0.971	4.770	2.457	*2.000*	*2.961*	*6.045*	-1.450	1.659
RSQE	0.937	*2.096*	2.460	*2.726*	*3.416*	*6.401*	0.824	1.659
Smith Barney	0.955	2.670	2.494	*2.544*	*3.308*	*4.277*	*2.238*	1.664
Standard&Poor's	0.920	*2.394*	2.445	*3.239*	*4.164*	*6.833*	1.631	1.657
US Trust	0.931	4.093	2.453	*2.234*	*2.898*	*6.513*	1.339	1.658
WEFA Group	0.867	4.293	2.476	*1.887*	*3.089*	*7.362*	-0.247	1.662
Wells Fargo	0.838	3.877	2.503	1.086	*2.864*	*5.350*	-3.759	1.666

Efficiency F-test critical value on 0.95 significance level; modified Diebold-Mariano test critical value on 0.95 significance level.

Table 11 Results of sign accuracy test

Institution	Ten-year US-Government bond yield forecasts				Three-month US-Treasury bill rate forecasts			
	13 month forec. horizon		4 month forec. horizon		13 month forec. horizon		4 month forec. horizon	
	χ^2-dist.	result	χ^2-dist.	result	χ^2-dist.	result	χ^2-dist.	result
Consensus Forec.	4.375	+	2.458	o	2.018	o	20.107	+
Amoco Corp.	9.877	+	0.279	o	8.671	+	3.336	o
Chase Manhattan	0.574	o	0.245	o	0.937	o	4.701	+
Chemical Bank	0.709	o	3.755	o	0.105	o	0.002	o
Conference B.	0.536	o	1.754	o	0.087	o	0.156	o
Continental Bank	0.291	o	3.511	o	1.209	o	3.899	+
Core/FU/Wacho.	0.300	o	2.847	o	0.028	o	16.311	+
CSFB	0.220	o	0.032	o	5.331	+	17.565	+
Daimler/Chrysler	0.885	o	1.427	o	7.658	+	8.403	+
Dun & Bradstreet	0.081	o	0.016	o	0.758	o	9.401	+
DuPont	10.505	+	0.403	o	0.727	o	1.045	o
Eaton Corp.	0.048	o	0.341	o	1.036	o	0.767	o
Fannie Mae	2.758	o	0.992	o	0.769	o	3.146	o
Ford Motors	7.676	-	0.019	o	3.833	o	1.942	o
General Motors	0.733	o	0.298	o	0.223	o	1.551	o
Georgia State Un.	1.763	o	0.137	o	0.180	o	6.527	+
Griggs & Santow	0.124	o	1.306	o	1.213	o	5.435	+
Inforum	2.260	o	0.732	o	2.237	o	0.922	o
J. P. Morgan	0.279	o	1.191	o	1.149	o	3.591	o
Merrill Lynch	0.322	o	0.117	o	0.862	o	3.968	+
Metropolitan Life	12.440	+	0.119	o	14.915	+	5.178	+
Mortage Bankers	0.327	o	1.287	o	0.460	o	0.001	o
N. A. Homebuild.	6.132	-	7.082	-	0.305	o	1.416	o
N. A. Manufact.	6.195	-	1.779	o	11.239	+	4.990	+
Northern Trust	0.004	o	1.386	o	3.359	o	12.986	+
OEF	15.767	+	0.343	o	2.839	o	1.645	o
Prudential Insur.	0.124	o	0.722	o	0.182	o	1.147	o
Regional Fin. A.	2.233	o	5.096	-	3.734	o	0.492	o
RSQE	1.489	o	0.017	o	4.382	-	5.368	+
Smith Barney	23.333	+	1.630	o	1.460	o	12.114	+
Standard&Poor's	11.489	-	0.542	o	0.869	o	13.031	+
US Trust	0.145	o	0.038	o	0.199	o	0.882	o
WEFA Group	0.185	o	5.954	-	1.183	o	0.805	o
Wells Fargo	6.009	-	14.760	-	7.747	-	0.002	o

Critical value on 0.95 significance level = 3.8414; o = not significantly different from a random process; + = significantly better than a random process; - = significantly worse than a random process.

The sign accuracy tests also lead to a mixed evaluation of the forecasting performance of the institutes analyzed (Table 11). In the forecasts of the 10-year US-Government bond yield with a forecast horizon of 13 months, 6 out of 34 institutes achieve significant success in the estimation of the direction of interest rate development (rising or falling). Five institutes forecasted the direction of interest rate development significantly worse than a random walk forecast. In the case of the remaining 23 institutes, no significant difference to a random walk forecast can be recognized. In the corresponding forecasts with a four-month forecast horizon, a sobering picture is revealed. Four institutes predicted the trend more poorly than a random walk forecast would have done; the remaining forecast time series do not differ significantly from a random walk forecast.

The forecasts of the 3-month US-Treasury bill rate with a forecast horizon of 13 months do not fare much better (Table 11). Five forecast time series predict the interest rate trend (rising or falling) significantly better and two forecast time series significantly worse than a random walk forecast. In 27 of the forecast time series no difference to a random walk forecast can be recognized. A somewhat more favorable picture is offered by the corresponding forecasts with a four-month forecast horizon. 16 out of 34 forecast time series (47.1%) predict the interest rate trend significantly better than a random walk forecast. The remaining 18 time series are not significantly different from a random walk forecast.

The results are very clear with respect to the TOTA coefficient (Tables 7-10). In all of the 136 forecast time series analyzed there is a topically orientated trend adjustment. This means that the forecasts agree more strongly with the events actually occurring at the time of their creation than with those at the time of their validity. The forecasts thus tend to reflect the present (or the very recent past) more than the future. This phenomenon can be very well illustrated in a graphical form.

At first, the time series of the combined forecasts of Consensus Economics (ten-year US-Government bond yield forecasts with a forecast horizon of 13 months) is examined (Figure 1). It is obvious that the forecast time series reflects the actual movement of interest rates very insufficiently. Thus the forecast for October 1994 designates a local interest rate low of 5.7%, but actually there is a local interest rate high of 7.9%. In January 1996 a local interest rate high of 7.9% is forecast, while in reality there is a

local interest rate low of 5.6%. Again, in January 2000 the interest rate level is significantly underestimated. While the forecast expects a local interest rate low of 5.0%, a local interest rate high of 6.6% appears. May 2003 provides an absolute interest rate low of 3.4% whereas the forecast suggests a local interest rate high of 5.7%.

Yet it is apparent that the forecast time series corresponds with the actual movement of interest rates in a certain way. The forecast time series seems to be a delayed image of the factual time path of interest rates. The forecast lags behind reality. This is especially recognizable when the forecast data are each shifted left by their forecast horizon (13 months), so that the forecast data are no longer attributed to their respective points of validity but to their respective points of time when forecasts were issued (Figure 2). This projection indicates that the market experts were highly influenced by the current market situation. It could be claimed that not the future, but merely the present is "forecast". There is obviously a topically orientated trend adjustment for this time series. The TOTA coefficient value is 0.469 and thus confirms the topically orientated trend adjustment.

To show that the characteristics of the forecast time series of Consensus Economics are not a special case, some further examples are presented as charts. The forecast time series of Core States / First Union / Wachovia (Figures 3 and 4), as well as Eaton Corp. (Figures 5 and 6) show the same obvious shortcomings. Even worse are the results of the 10-year Government bond yield forecasts with a forecast horizon of four months (see Figures 7-8 and Table 8). The 3-month US Treasury bill rate forecasts are hardly more successful (see Figures 9-10 and Tables 9 and 10). For all examined forecast times series a TOTA coefficient < 1 is calculated. Thus all 136 cases reflect a topically orientated trend adjustment. The graphic analysis also shows that the analysts are strongly oriented towards the current, or past, market situation when they generate their forecasts.

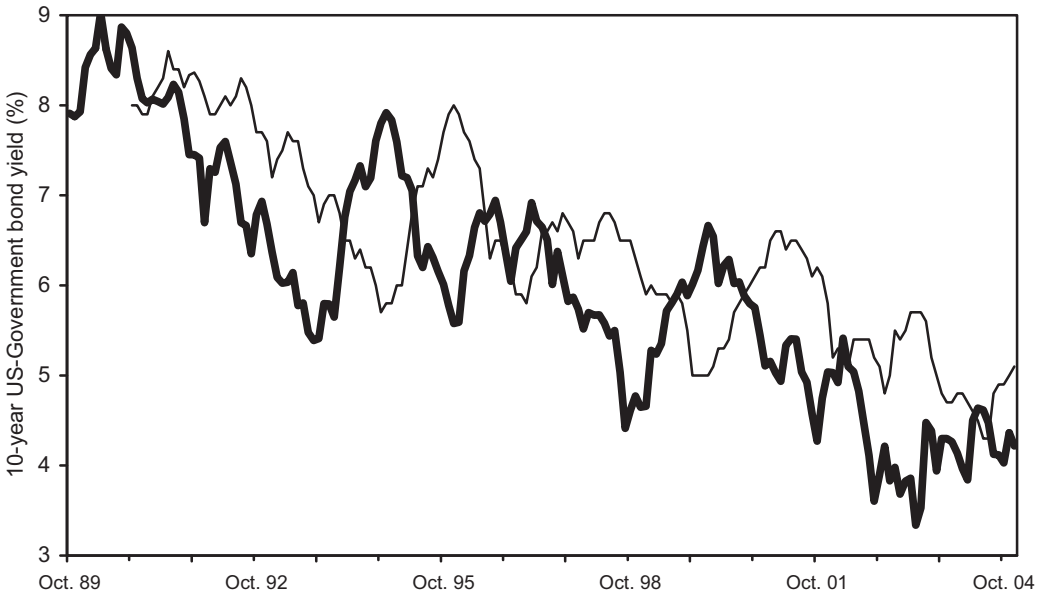

Fig. 1 Ten-year US-Government bond yield (bold line) and respective forecasts of Consensus Economics with 13 months forecast horizon (thin line).

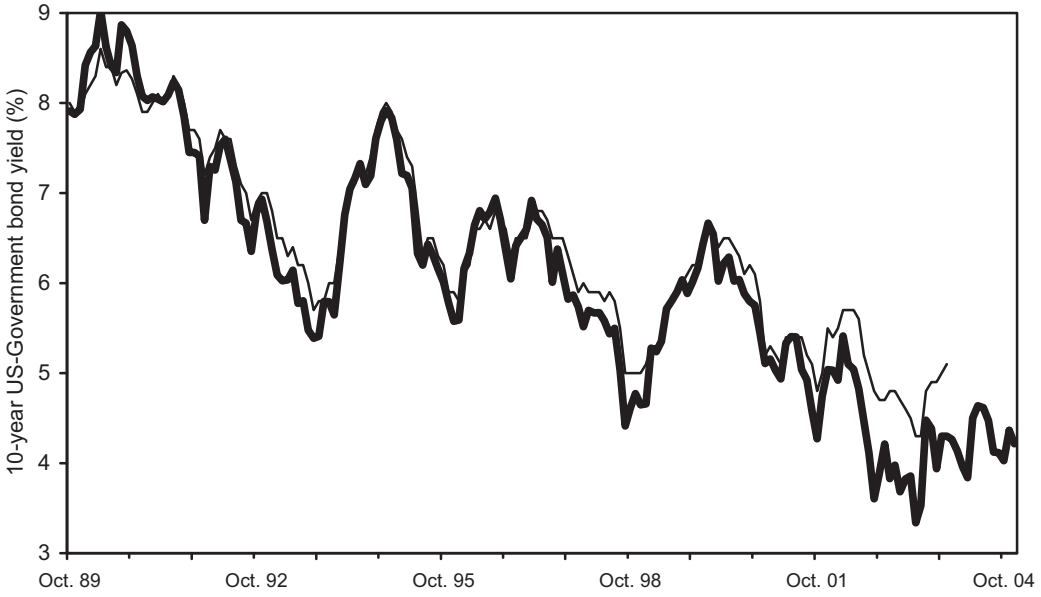

Fig. 2 Ten-year US-Government bond yield (bold line) and forecasts from Consensus Economics shifted to the left by 13 months (thin line).

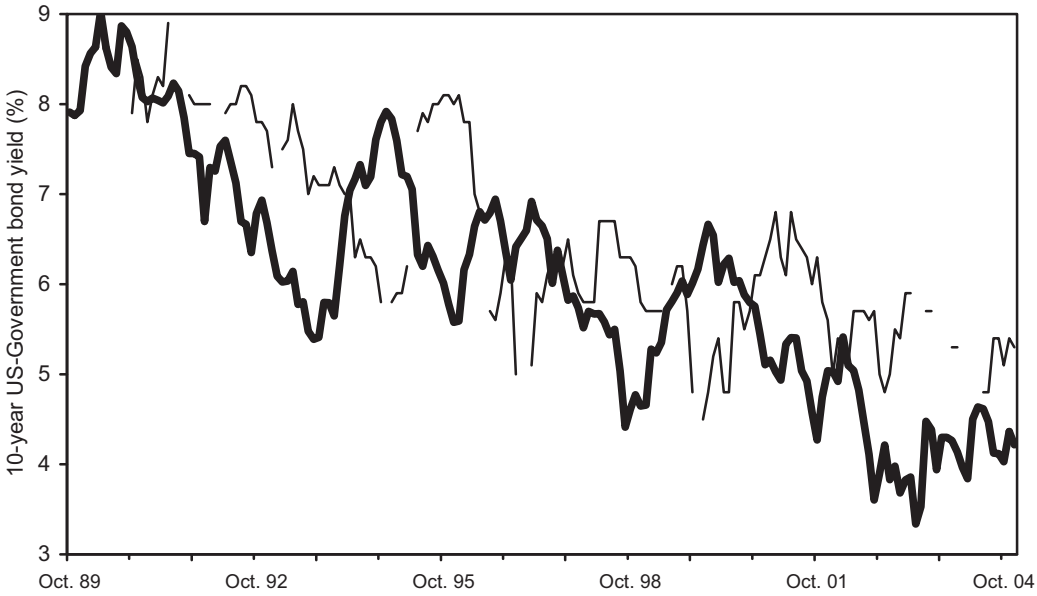

Fig. 3 Ten-year US-Government bond yield (bold line) and respective forecasts of Core States / First Union / Wachovia with 13 months forecast horizon (thin line).

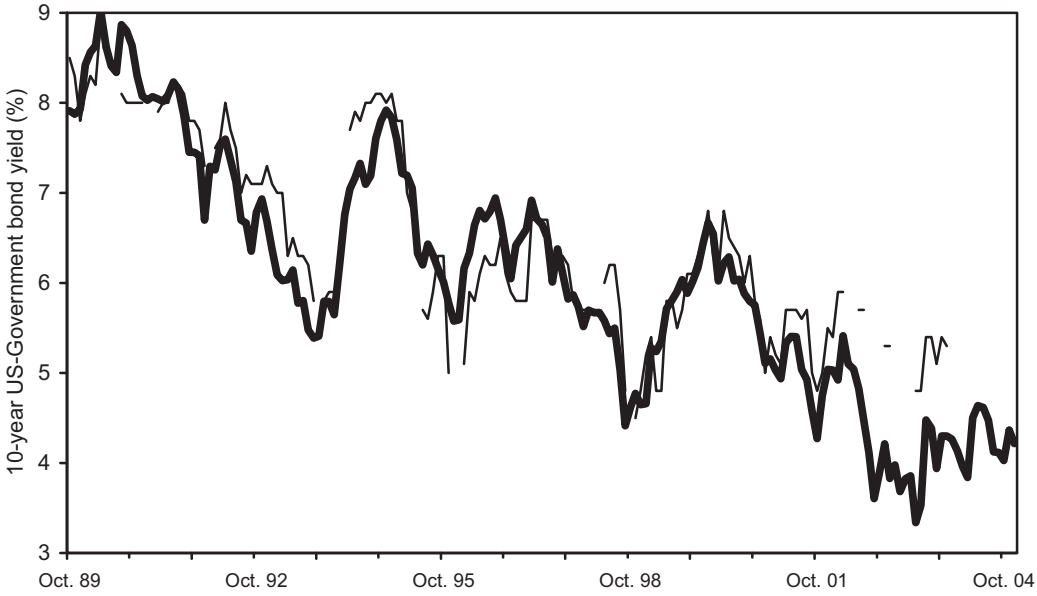

Fig. 4 Ten-year US-Government bond yield (bold line) and forecasts from Core States / First Union / Wachovia shifted to the left by 13 months (thin line).

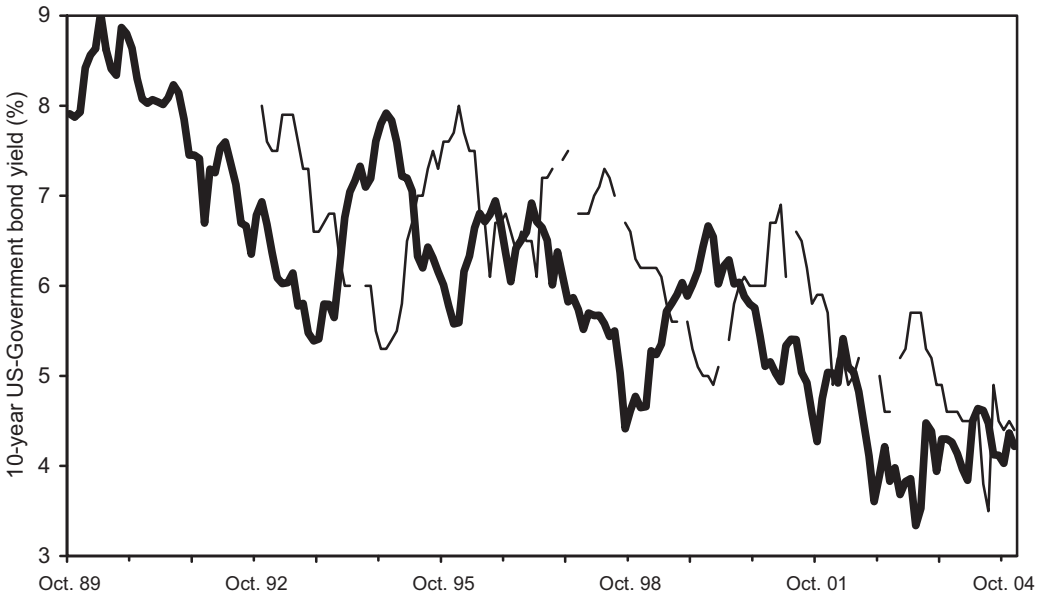

Fig. 5 Ten-year US-Government bond yield (bold line) and respective forecasts of Eaton Corp. with 13 months forecast horizon (thin line).

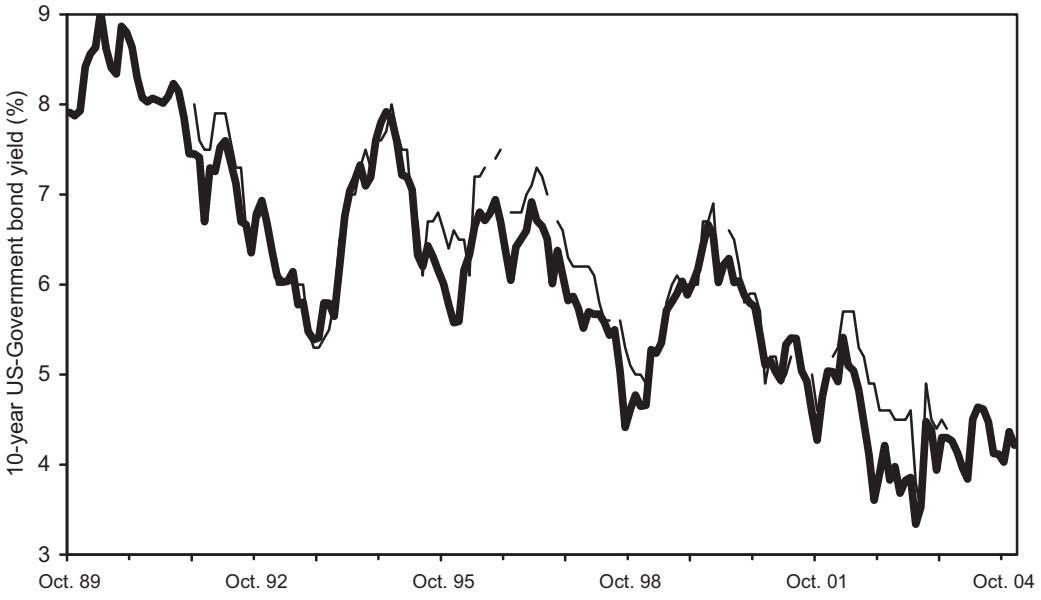

Fig. 6 Ten-year US-Government bond yield (bold line) and forecasts from Eaton Corp. shifted to the left by 13 months (thin line).

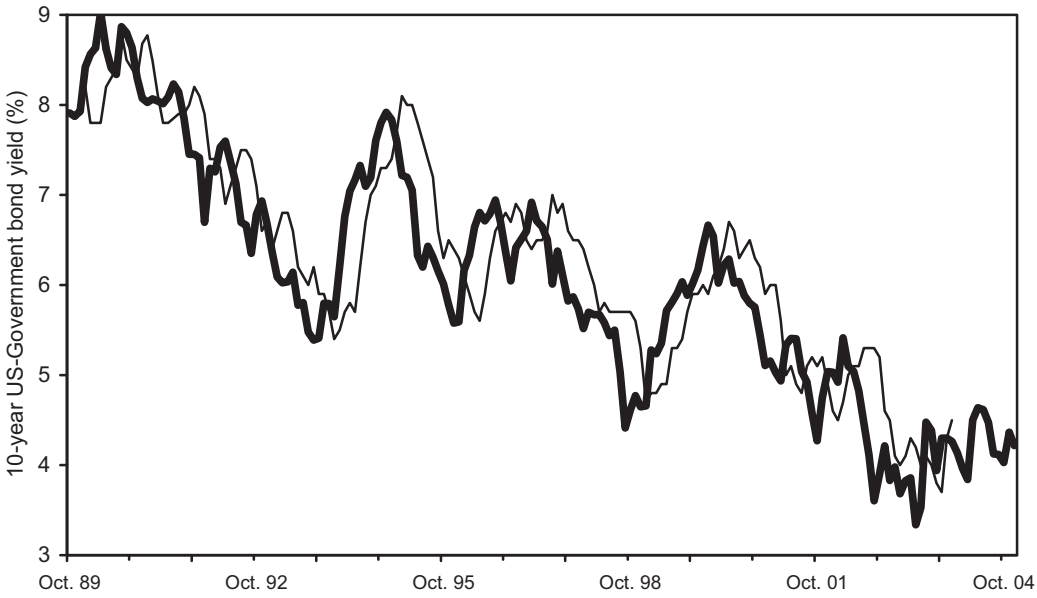

Fig. 7 Ten-year US-Government bond yield (bold line) and respective forecasts of Consensus Economics with 4 months forecast horizon (thin line).

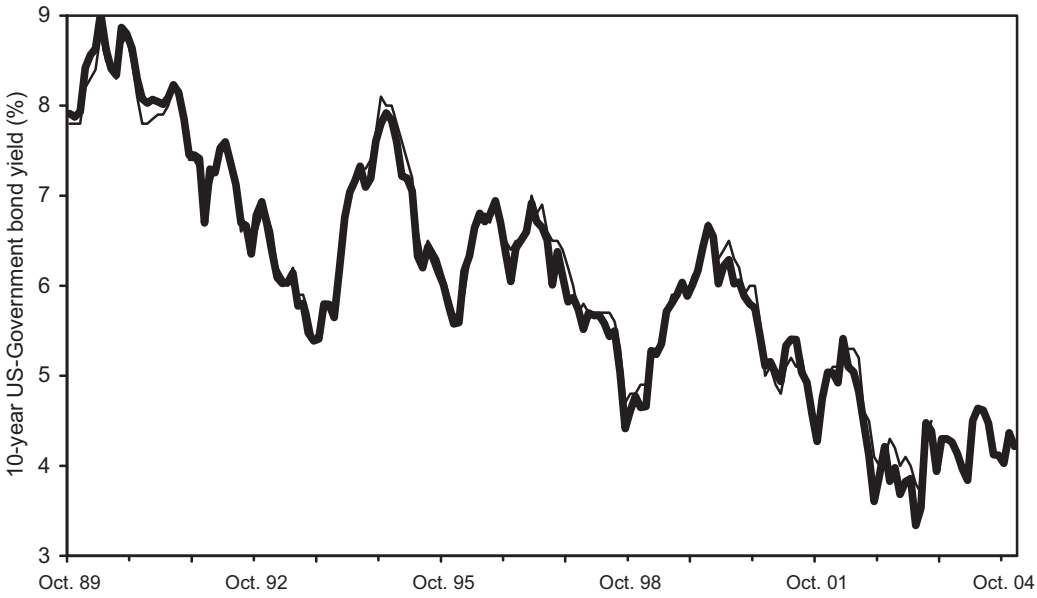

Fig. 8 Ten-year US-Government bond yield (bold line) and forecasts of Consensus Economics shifted to the left by 4 months (thin line).

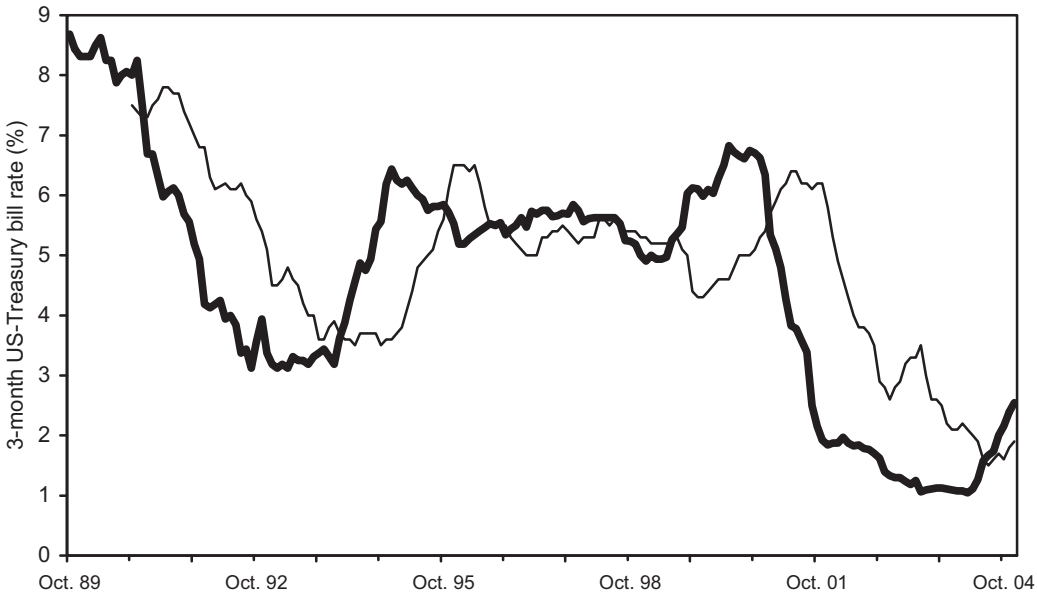

Fig. 9 Three-month US-Treasury bill rate (bold line) and respective forecasts of Consensus Economics with 13 months forecast horizon (thin line).

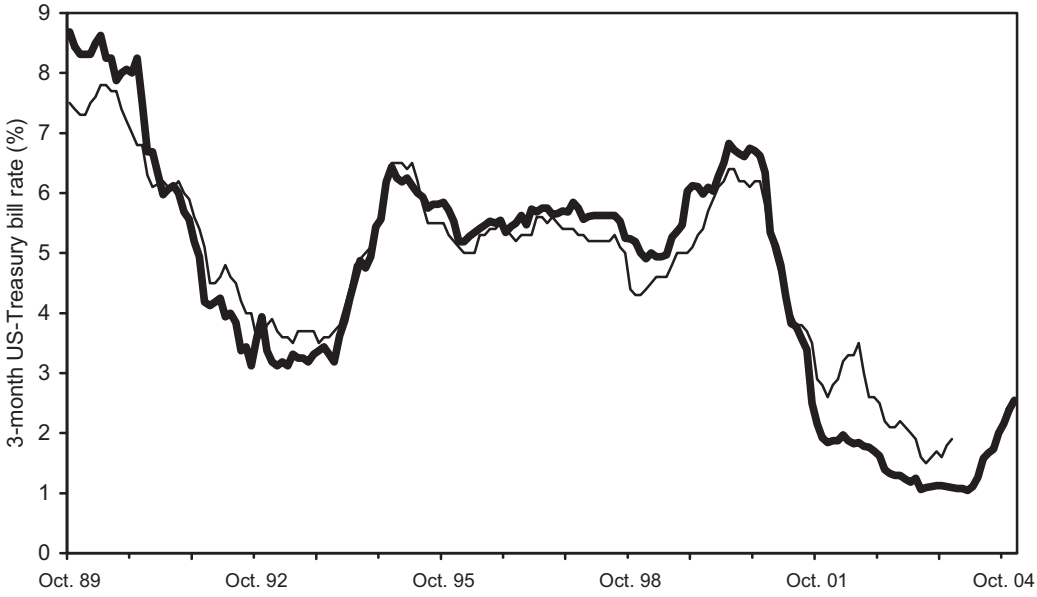

Fig. 10 Three-month US-Treasury bill rate (bold line) and forecasts from Consensus Economics shifted to the left by 13 months (thin line).

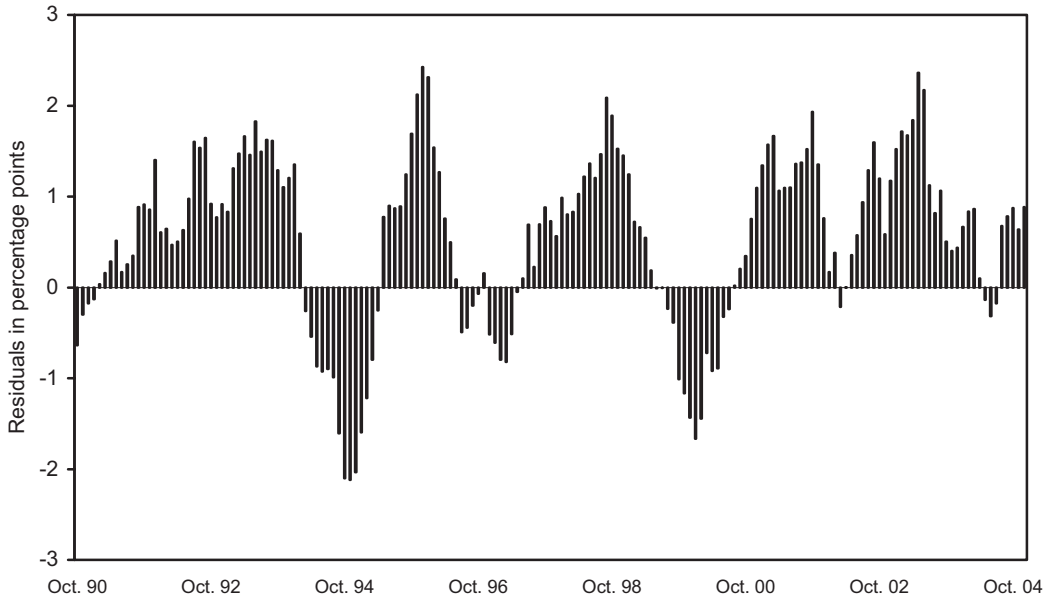

Fig. 11 Differences between the 10-year US-Government bond yield and the corresponding forecasts by Consensus Economics with a forecast horizon of 13 months.

This behavior of the forecasters also contains the reason why none of the analyzed forecast time series is unbiased. During phases in which interest rates are rising there are long periods of underestimation, and in phases where rates are falling there are long periods of overestimation of the actual future interest rate level. An example for this is the forecast of the 10-year US-Government bond yield from Consensus Economics with a forecast horizon of 13 months (Figure 11). It is immediately recognizable here that the residuals u_t are not randomly distributed. The situation is very similar in all the other forecast time series.

Finally, the modified Diebold-Mariano test for forecast encompassing is carried out. Here, the forecast time series are compared with four different benchmarks: 1. the (no change) naïve forecast, 2. a simple ARIMA model, 3. the rate expectations of the capital market in the form of implicit forward rates and 4. the average rate expectations of capital market analysts (consensus forecasts).

For the 10-year US-Government bond yield forecasts, the four benchmarks provide a very uniform picture (Tables 7 and 8). Sixty-two of the 68 forecast time series

(91.2%) exhibit an information content which does not go significantly beyond any of the four benchmarks. Three forecast time series beat all four of the benchmarks. Only three of the total of 68 forecast time series exhibit mixed results. They only bear scrutiny with one of the four benchmarks. When applied to this forecast subject, the four benchmarks thus prove to be very comparable. The limitation to only one benchmark would also not have led to any appreciable deviations in the results.

The result of the Diebold-Mariano test is rather sobering overall. Only three out of 68 forecast time series (4.4%) predict the future interest rate trend significantly better than a naïve forecast, a simple ARIMA model, the implicit forward rates and the consensus forecast. In 95.4% of the cases, results which are not significantly worse than the forecasting quality of the experts can be achieved with the simplest forecasting approach, a (no change) naïve forecast.

In the case of the 3-month US-Treasury bill rate forecasts, however, the four benchmarks prove to be rather varying standards of comparison. With a forecast horizon of 13 months (Table 9), the naïve forecast, the ARIMA model and the consensus forecast reveal themselves to be comparatively strict benchmarks. None of the forecast time series has an information content which goes significantly beyond that of the naïve forecast. Two time series exceed the information content of the ARIMA model and four time series exceed that of the consensus forecast. On the other hand, 20 out of the 34 forecast time series (58.8%) exceed the information content of the implicit forward rate. This shows that the critical posture of some authors (e.g. Schulte, Allendorf and Schieble, 1995; Ilmanen, 1996) towards the significance of implicit forward rates in this context is not unfounded.

With a forecast horizon of four months (Table 10), the naïve forecast, the ARIMA model and the implicit forward rates reveal themselves to be not particularly strict benchmarks. 33 out of 34 forecast time series (97.1%) prove to be superior to the ARIMA model. The information content of the implicit forward rates is even exceeded by all 34 forecast time series. The naïve forecast proves to be a somewhat higher hurdle, although 24 of the 34 forecast time series (70.6%) do at least exceed the information content of the naïve forecast.

Overall, it can be stated that the 3-month US-Treasury bill rate forecasts with a forecast horizon of four months are clearly more successful than the other forecasts. This may be due to the fact that the Federal Reserve's policy has a considerable effect on interest rate trends for short maturities and that it usually indicates how it will act in the near future. So-called "Fed watching" may therefore have led to the successful forecasts.

This partial success is slightly spoiled by the fact that only six of the 34 forecast time series (17.7%) go significantly beyond the information content of the consensus forecast. However, in view of the fact that the forecast time series are usually largely similar to each other (please refer to e.g. Spiwoks, 2004), this result is not surprising.

5 Study results and conclusion

The most important results of this study can be summarized as follows:

- None of the 136 forecast time series analyzed can be considered unbiased.
- 96 out of the 136 forecast time series (70.6%) use information from the very recent past in an inefficient way.
- 109 out of 136 forecast time series (80.2%) do not recognize the interest rate trend (rising or falling) significantly better than a random walk forecast.
- All 136 forecast time series reveal a clear topically orientated trend adjustment. They therefore tend to agree more with the present (or with the very recent past) than with the future.
- 109 out of 136 forecast time series (80.2%) exhibit an information content which is significantly lower than that of the corresponding naïve forecast.
- The performance of 98 out of 136 forecast time series (72.1%) is not significantly better than the corresponding ARIMA forecasts.
- 77 out of 136 forecast time series (56.6%) have a forecast quality which is significantly below that of the implicit forward rates.
- 122 out of 136 forecast time series (89.7%) do not go beyond the interest rate expectations of capital market analysts in the form of consensus forecasts.

All in all, it can be stated that the efforts made to forecast the 10-year US-Government bond yield largely failed. The forecasting attempts with respect to the 3-month US-

Treasury bill rate with a forecast horizon of 13 months also have to be considered unsuccessful. Only the short-term forecast of the 3-month US-Treasury bill rate shows clearly more success.

It is particularly noticeable that all of the analyzed forecast time series exhibit TOTA coefficient results of < 1. Individual findings for the occurrence of topically orientated trend adjustments in capital market forecasts have been presented since as early as the late 1980s (Manzur, 1988; Allen and Taylor, 1990; Takagi, 1991). But it is only in the past five years that a number of studies have shown that this could be a general characteristic of capital market forecasts (e.g. Spiwoks, 2003; Bofinger and Schmidt, 2003; Brooks and Grey, 2004; Harrison and Mogford, 2004; Spiwoks and Scheier, 2006; Spiwoks and Hein, 2007). This study offers for the first time comprehensive evidence for the presence of topically orientated trend adjustments in forecasts for the world's largest and most important bond market. This will certainly intensify the further analysis of this phenomenon.

The discourse on what actually causes topically orientated trend adjustments in capital market forecasts is still in its infancy. Bofinger and Schmidt (2003) consider the anchoring heuristic to be the cause. Spiwoks (2004) works on the assumption that the phenomenon is based on a specific type of rational herding behavior. But other individual psychological processes and other processes of social influence are now also being discussed as possible causes.

The connection between the results of the unbiasedness test and the TOTA coefficient are striking. The autocorrelation of the residuals can be traced back (at least partly) to topically orientated trend adjustments. It is thus necessary to get to the bottom of this phenomenon in order to be able to work towards an improvement of forecast reliability.

The practical consequences arising from the unsatisfying quality of the interest rate forecasts are extensive:

In the face of the weaknesses regarding the forecasting of the market-determining 10-year US-Government bond yields, a reliable forecast of the future movements of interest rates seems, on the whole, not to be guaranteed. It is therefore not possible to master the risk of changing interest rates when dealing with maturity transformation

solely with the aid of interest rate forecasts. A critical inspection of the maturity transformation volume as well as a consistent use of the known procedures of risk evaluation and limitation appears to be urgently recommended against the background of these study results.

Without the necessary reliability of interest rate forecasts, active investment strategies in the bond market cannot lead to the desired success, namely the achievement of systematic surplus yields. As active investment strategies are also relatively expensive, a stringent orientation towards passive investment strategies should be pursued.

Against the background of the low reliability of interest rate forecasts established here, other financial market forecasts should also be critically examined with regard to their accuracy, because fundamental stock market and exchange rate forecasts normally rely on assumptions on the future movement of interest rates. All research results should be subject to thorough, systematic checks in order to avoid false assumptions regarding one's own forecasting competence.

Finally, industrial companies should not make their timing of real investments dependent on expected changes of the cost of finance.

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