Executive Summary

The interest rate is a key financial variable that affects decisions of consumers, businesses, financial institutions, professional investors and policymakers. Movements in interest rates have important implications for the economy's business cycle and are crucial to understanding financial developments and changes in economic policy. Timely forecasts of interest rates can therefore provide valuable information to financial market participants and policymakers. Forecasts of interest rates can also help to reduce interest rate risk faced by individuals and firms. Forecasting interest rates is also very useful to central banks in assessing the overall impact (including feedback and expectation effects) of its policy changes and taking appropriate corrective action, if necessary. In fact, the usefulness of the information contained in interest rates greatly increases particularly with financial sector liberalisation.

In the Indian context, the progressive deregulation of interest rates across a broad spectrum of financial markets was an important constituent of the package of structural reforms initiated in the early 1990s. As part of this process, the Reserve Bank has taken a number of initiatives in developing financial markets, particularly in the context of ensuring efficient transmission of monetary policy.

Against this backdrop, the objective of this study is to develop models to forecast short-term and long-term rates: call money rate, 15-91 days Treasury bill rate and rates on 1-year, 5-years and 10-years government securities. Univariate as well as multivariate models are estimated for each interest rate. Univariate models include Autoregressive Integrated Moving Average (ARIMA) models, and ARIMA models with Autoregressive Conditional Heteroscedasticity (ARCH)/Generalised Autoregressive Conditional Heteroscedasiticity (GARCH) effects while multivariate models include Vector Autoregressive (VAR) models specified in levels, Vector Error Correction Models (VECM), and Bayesian Vector Autoregressive (BVAR) models. In the multivariate models, factors such as liquidity, Bank Rate, repo rate, yield spread, inflation, credit, foreign interest rates and forward premium are considered. The random walk model is used as the benchmark for evaluating the forecast performance of each model.

Evaluation of Forecasting Models

For each interest rate, a search for the "best" forecasting model is conducted. The "best model" is defined as one that produces the most accurate forecasts such that the predicted levels are close to the actual realized values. Furthermore, the predicted variables should move in the same direction as the actual series. In other words, if a series is rising (falling), the forecasts should reflect the same direction of change. If a series is changing direction, the forecasts should also identify this. To select the best model, the alternative models are initially estimated using weekly data over the period April 1997 through December 2001 and out-of-sample forecasts up to 36-weeks-ahead are made from January through September 2002. In other words, by continuously updating and reestimating, a real world forecasting exercise is conducted to see how the models perform.

Main Findings for Each Interest Rate

The variables employed in the multivariate models as well as the specific conclusions with respect to the various interest rates are given below.

Call money rate

- The multivariate models for the call money rate include the following: inflation rate (week-to-week), Bank Rate, yield spread, liquidity, foreign interest rate (3-months Libor), and forward premium (3-months).
- Evaluation of out-of-sample forecasts for the call money rate suggests that an ARMA-GARCH model is best suited for very short-term forecasting while a BVAR model with a loose prior can be used for longer-term forecasting.

Treasury Bill rate (15-91 days)

The following variables are included in the multivariate models for the Treasury Bill rate (15-91 days): inflation rate (year-on-year), Bank Rate, yield spread, liquidity, foreign interest rate (3-months Libor), and forward premium (3-months).

- In the case of the 15-91 day Treasury Bill rate, the VAR model in levels produces the most accurate short- and long-term forecasts.

Government Security 1 year

- The multivariate models for 1 year government securities utilize the following variables: inflation rate (year-on-year), Bank Rate; yield spread, liquidity, foreign interest rate (6-months Libor), forward premium (6-months).
- The performance of the out-of-sample forecasts for 1-year government securities indicates that BVAR models out-perform the alternatives at the short and long ends.

Government Security 5 years

- The multivariate models for 5 years government securities include the following: inflation rate (year-on-year), Bank Rate; yield spread, credit, foreign interest rate (6-months Libor), and forward premium (6-months).
- For 5-year government securities, the BVAR models do not perform well. Overall, VECM outperforms all the alternative models. VECM also generally outperforms the alternatives at the short and long run forecast horizons.

Government Security 10 years

- The following variables are used in the multivariate models for 10 years government securities: inflation rate (year-on-year), Bank Rate, yield spread, credit, foreign interest rate (6-months Libor), and forward premium (6-months).
- The forecasting performance of all the models is satisfactory for 10-year government securities. The model that produces the most accurate forecasts is a VAR in levels (LVAR); in other words, a BVAR with a very loose prior. The LVAR model also produces the most accurate short- and long-term forecasts.

The selected models conform to expectations. Standard ARIMA models are based on a constant residual variance. Since financial time series are known to exhibit volatility clustering, this effect is taken into account by estimating ARCH/GARCH models. It is found that although the ARCH/GARCH effects are significant, the ARCH model produces more accurate out-of-sample forecasts relative to the corresponding ARIMA model only in the case of call money rate. This result is not surprising since the out-of sample period over which the alternative models are evaluated is relatively stable with no marked swing in the interest rates.

It is also found that the multivariate models generally produce more accurate forecasts over longer forecast horizons. This is because interactions and dependencies between variables become stronger for longer horizons. In other words, for short forecast horizons, predictions that depend solely on the past history of a variable may yield satisfactory results.

In the class of multivariate models, the Bayesian model generally outperforms its contenders. Unlike the VAR models, the Bayesian models are not adversely affected by degree of freedom constraints and overparameteiztion. In two cases, i.e., for TB 15-91 and GSec 10, the level VAR performs best suggesting that a loose prior is more appropriate for these models. Notice that with a loose prior, the Bayesian model approaches the VAR model with limited restrictions on the coefficients.

The VECM model outperforms the others only in the case of the GSec 5-years rate. Although inclusion of an error correction term in a VAR is generally expected to improve forecasting performance if the variables are indeed cointegrated, this contention did not find support in this study. This may be because cointegration is a long run phenomenon and the span of the estimation period in this study is not sufficiently large to permit a rigorous analysis of the long-run relationships. Thus, it is not surprising that the VAR models generally outperform the corresponding VECM forecasts.

Thus, to sum up, the forecasting performance of BVAR models for all interest rates is satisfactory. The BVAR models generally produce more accurate forecasts compared to the alternatives discussed in the study and their superiority in performance is marked at longer forecast horizons. The variables included in the optimal BVAR models are: inflation, Bank Rate, liquidity, credit, spread, libor 3-and 6-months and forward premium 3- and 6-months. These variables are selected from a large set of potential series including the repo rate, cash reserve ratio, foreign exchange reserves, exchange rate, stock prices, advance (centre and state government advance by RBI), turnover (total turnover of all maturities), 3-and 6-months US Treasury Bill rate (secondary market), reserve money and its growth rates.