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Option-based forecasts of volatility: an empirical study in the DAX-index options market

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Abstract

Volatility estimation and forecasting are essential for both the pricing and the risk management of derivative securities. Volatility forecasting methods can be divided into option-based ones, which use prices of traded options in order to unlock volatility expectations, and time series volatility models, which use historical information in order to predict future volatility. Among option-based volatility forecasts, we distinguish between the 'model-dependent' Black–Scholes implied volatility and the 'model-free' implied volatility, proposed by Britten-Jones and Neuberger [Option prices, implied price processes and stochastic volatility. Journal of Finance 55: 839–66], that does not rely on a particular option pricing model. The aim of this paper is to investigate the unbiasedness and efficiency, with respect to past realised volatility, of the two option-based volatility forecasts. The comparison is pursued by using intra-daily data on the

DAX-index options market. Our results suggest that Black–Scholes implied volatility subsumes all the information contained in past realised volatility and is a better predictor for future realised volatility than model-free implied volatility.

Keywords:

Black–Scholes implied volatility

model-free implied volatility

volatility forecasting

JEL Classification :

G13

G14

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Notes

The data source for DAX-index options and DAX-index is the Institute of Finance, Banking, and Insurance of the University of Karlsruhe (TH). The risk-free rate is available on Data-Stream.

Nonetheless, as the computation of B–S and model-free implied volatilities has involved some methodological choices deeply described in Section 5, we pursue an EIV procedure in order to see if there is any error in variables in the B–S implied volatility or in the model-free implied volatility. The instruments used for B–S implied volatility (model-free implied volatility) are both historical volatility and past B–S implied volatility (model-free implied volatility) as they are possibly correlated with the true B–S implied volatility (model-free implied volatility), but unrelated to the measurement error associated with B–S implied volatility (model-free implied volatility) 1 month later. As an indicator of the presence of errors in variables, we use the Hausman (1978) specification test statistic (m), which is defined as , where is the beta obtained through the two stage least squares procedure, is the beta obtained through the OLS procedure and Var(x) is the variance of the coefficient x. The Hausman specification test is distributed as a χ^2 (1).

In the regressions that include as an explanatory variable lagged realised volatility, the Durbin's alternative confirmed the non-autocorrelation of the residuals. The results of the Durbin's alternative and of the Breusch–Godfrey LM test are available on request.

The non-normality of the residuals is caused by one outlier that corresponds to the September 2001 crash. In order to eliminate the effect of the outlier, regressions (5)–(8) have been re-estimated on the sample period 26 September 2001 to 31 December 2005 and the results, which are available on request, are consistent with the ones reported for the entire sample period.

In order to see if B–S implied volatility or model-free implied volatility have been measured with errors, we adopt an instrumental variable procedure. The Hausman (1978) specification test reported in the last column of Table 2 indicates that the errors-in-variables problem is not significant both in univariate and encompassing regressions (In encompassing regression (3), the results are reported for the instrumental variable procedure applied to). Therefore we can trust the OLS regressions results.

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