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How useful is intraday data for evaluating daily Value-at-Risk? Evidence from three Euro rates

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Abstract

Previous research concerned with the investigation of intraday data has typically sought to model that data using techniques to control for intraday periodicity, has applied models of short-horizon and long-horizon dependencies, or has utilised intraday data in the construction of realised variance. Using Euro exchange rate data, we apply these different modelling strategies in forecasting daily volatility and calculating Value-at-Risk measures, benchmarked against a standard GARCH model for daily and raw intraday returns. Our results suggest that the use of intraday data provides improved daily volatility and VaR forecasts relative to daily data and daily realised volatility. Further, use of the raw intraday data, or intraday data subjected to a simple standardisation procedure, provides better forecasts and VaR measures than more complicated models for intraday periodicity. These results also hold in a multi-asset portfolio setting.

JEL classification: C22; G12

Keywords: Value-at-Risk; Volatility; Intraday data; Exchange rates

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1. Introduction

Variation in market returns and other economy-wide risk factors are crucial factors in asset and portfolio management and play a key role in derivative pricing models (Christoffersen and Diebold, 2000). A commonly adopted tool for the measurement of the risk exposure associated with a particular portfolio of assets involves calculation of the expected losses that might result from changes in the market prices of particular securities, or 'Value-at-Risk' (VaR) (Jorion, 2001; Bessis, 2002). The validity of such VaR calculations are typically assessed or 'backtested' by comparing actual daily trading (net) losses with the estimated VaR and noting the number of 'exceptions', in the sense of days when the VaR estimate was insufficient to cover actual trading losses. Regulatory concerns naturally arise where such exceptions occur frequently, and can result in a range of penalties for the financial institution concerned (Saunders and Cornett, 2003).

A crucial parameter in the implementation of parametric VaR calculation methods is an estimate of the volatility parameter that describes the asset or portfolio, or, more accurately, a forecast of that volatility where the simplifying assumption of constancy is relaxed and time-varying volatility is acknowledged. A popular econometric approach to the modelling and forecasting of time-varying volatility involves a variety of adaptations of the basic generalised autoregressive conditional heteroskedasticity (GARCH) model applied to daily frequency financial data. However, the increasing availability and utilization of intraday data in recent years has led to a range of developments concerned with the modelling of daily volatility which are yet to be appraised in the context of daily VaR calculation. These have included the introduction of new econometric techniques and models to deal with the novel features of intraday data, as well as the development of new measures of volatility constructed using the additional information contained at the higher intraday data frequencies. Amongst these empirical methods are techniques designed to deal with the regularities and complexities peculiar to intraday data, which involve filtering techniques to control for the intraday periodicity in asset return volatility, and the application of models designed to capture the presence of both short-run and long-horizon volatility dependencies. A prominent and parallel development in the application of intraday data has involved the use of data aggregated from the higher intraday frequencies to produce lower frequency daily 'realised volatility' measures. Subsequently, realised volatility has itself become a variable of interest to be modelled and forecast, such that standard linear estimation techniques applied to daily realised volatility may provide improved forecasts over GARCH or similar models. Both of these developments would appear to have potential importance for the practice of risk management. For example, more appropriate and accurate estimates of the volatility parameter provide the potential to offer improvements in option pricing and the calculation of Value-at-Risk estimates. However, to date, these two lines of inquiry in the intraday frequency empirical literature have developed largely in isolation, and particularly when applied to the practice of risk management.

The aim of this paper is therefore to consider models from both strands of the literature described above. That is, on the one hand, volatility forecasts from models which are based on utilising intraday data after adjustment to accommodate the intraday periodicity in volatility, and, on the other hand, volatility forecasts obtained from models which aggregate intraday data to provide daily measures of realised volatility. These models are also compared to a standard GARCH model applied to both daily data and the raw intraday returns data. In addition to appraising these daily volatility forecasts directly, these models are also appraised in terms of their ability to provide VaR measures. This latter exercise, in particular, may be of interest to portfolio and risk managers in answering two pertinent questions. First, whether it is better to use high-frequency intraday data or to use daily data in obtaining daily VaR estimates and, second, if high-frequency data is