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Forecasting exchange rate volatility: The superior performance of conditional combinations of time series and option implied forecasts☆

Guillermo Benavides [a,*], Carlos Capistrán [b]

[a] Banco de México, Mexico
[b] Bank of America Merrill Lynch, Mexico

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ABSTRACT

This paper provides empirical evidence that combinations of option implied and time series volatility forecasts that are conditional on current information are statistically superior to individual models, unconditional combinations, and hybrid forecasts. Superior forecasting performance is achieved by both, taking into account the conditional expected performance of each model given current information, and combining individual forecasts. The method used in this paper to produce conditional combinations extends the application of conditional predictive ability tests to select forecast combinations. The application is for volatility forecasts of the Mexican peso–US dollar exchange rate, where realized volatility calculated using intraday data is used as a proxy for the (latent) daily volatility.

1. Introduction

Even though several models are widely used by academics and practitioners to forecast volatility, nowadays there is no consensus about which method is superior in terms of forecasting accuracy (Andersen et al., 2006; Poon and Granger, 2003; Taylor, 2005). The vast majority of models can be classified in two classes: models based on time series, and models based on options.

There are basically two classes of models used in volatility forecasting: models based on time series, and models based on options (Poon and Granger, 2003). Among the time series models, there are models based on past volatility, such as historical averages of

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* Corresponding author at: Av 5 de Mayo # 2, Centro, México, D.F., CP. 06059, México. Tel.: +52 55 5237 2000x3877; fax: +52 55 5237 2559.
E-mail address: gbenavid@banxico.org.mx (G. Benavides).

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squared price returns, Autoregressive Conditional Heteroskedasticity-type models (ARCH-Type), such as ARCH, GARCH, and EGARCH, and stochastic volatility models.[1] Among the options based volatility models, typically called option implied volatilities (IV), there are the Black–Scholes-type models (Black and Scholes, 1973), the model-free, and those based on hard data on volatility trading.[2] Some authors believe that time series volatility forecasting models are superior because they are specifically designed to capture the persistence of volatility, a salient feature of financial volatility (Canina and Figlewski, 1993; Noh et al., 1994). Others believe that implied volatility is informational superior to forecasts based on time series models because it is the "market's" forecast, and hence it may be based on a wider information set and also may have a forward looking component (Xu and Taylor, 1995).

In part, the lack of consensus has led researchers to suggest that combining a number of volatility forecasts may be preferable. Patton and Sheppard (2009), and Andersen et al. (2006), among others, highlight the importance of analyzing in more detail composite specifications for volatility forecasting. Becker and Clemens (2008) show that combination forecasts of S&P 500 volatility are statistically superior to individual forecasts. Pong et al. (2004) and Benavides (2006) show that combinations of backward-looking and forward-looking forecasts can also be successfully used to forecast exchange rate volatility. This is intuitively appealing given that the volatility obtained from forward-looking methods may have different dynamics than the volatility obtained from backward-looking ones. Thus, combining them could be useful to incorporate features of several forecasting methods in one single forecast, aiming at obtaining a more realistic prediction of the volatility of a financial asset. In addition, combining forecasts has had a very respectable record forecasting other economic and financial variables (Timmermann, 2006).

There is some evidence in the combination literature, specifically to forecast macroeconomic variables, that time-varying combination schemes that condition the weights on current and past information may outperform linear combinations (Deutsch et al., 1994; Elliott and Timmermann, 2005; Guidolin and Timmermann, 2009). This time-varying type of forecast combinations may be particularly well suited for forecasting financial volatility due to the observed volatility clustering effect. If the dynamics of high volatility are well captured by a particular method (or set of methods), whereas the dynamics of low volatility are well captured by another method (or set of methods), then a time-varying combination of the forecasts may be the right tool to capitalize on their comparative advantage. This may be true even if one method seems to have an absolute advantage, or an absolute disadvantage.

Two specific time-varying combinations captured our attention, one proposed by Deutsch et al. (1994) with weights that change through time in a discrete manner, and the "Hybrid" forecast of Giacomini and White (2006) (GW), that recursively selects the best forecast. Deutsch et al.'s (1994) propose the use of switching regressions to estimate the appropriate combination weights, although they do not propose a method to select the variables that determine each regime. GW, in contrast, propose a technique, based on their conditional predictive ability test (CPA), to diagnose if current information can be used to determine which forecasting model will be more accurate at a specific future date. GW explore the model-selection implications of adopting a conditional perspective with a simple example of a two-step decision rule that tests for equal performance of the competing forecasts and then – in case of rejection – uses currently available information to select the best forecast for the future date of interest.

In this paper we show that the two-step procedure proposed by GW to select forecasting methods can be extended to select forecast combinations. This results in a conditional combination of the type suggested by Deutsch et al. (1994), but with the advantage that we can test if current information can be used to select the future regime. The extension is simple, as it involves the use of unconditional combinations in the second step.

In order to evaluate our proposed methodology, we first evaluate the forecasting accuracy of some of the most commonly used methods for financial volatility forecasting, as well as combinations of them, using data on the Mexican peso (MXN)–U.S. dollar (USD) exchange rate. The methods applied in this study are: 1) univariate Generalized Autoregressive Conditional Heteroskedasticity Models (GARCH; Bollerslev, 1986; Taylor, 1986); 2) hard data of implied volatilities from quotes recorded on trading in specific over-the-counter option's exchange rate deltas; 3) linear combinations of the aforementioned models' forecasts; and, 4) time-varying combinations, or what we call "conditional combinations".[3]

Our results indicate that statistically superior out-of-sample accuracy in terms of Mean Squared Forecast Errors (MSFEs) is achieved by conditional combinations of GARCH and (hard-data) IV exchange rate volatility forecasts. These time-varying combinations have weights that vary according to the past level of volatility, based on the fact that when the level of realized volatility is high, IV tends to perform better, whereas when the level of volatility is low, GARCH models tend to be relatively more accurate. Thus, our proposed conditional combinations take into account the comparative advantage of each, backward- and forward-looking volatility forecasting methods.

This study is carried out using MXN–USD intraday exchange rate data to construct a proxy for ex-post volatility to use as a benchmark for forecast evaluation purposes. As shown by Andersen and Bollerslev (1998), the intraday data can be used to form more accurate and meaningful ex-post proxies for the (latent) daily volatility than those calculated using daily data. To the best of our knowledge, high frequency data for this specific exchange rate has not been analyzed anywhere in terms of volatility forecasting.

The layout of this paper is as follows. Section 2 discusses the methodology used to obtain the individual forecasts, to combine them in linear and non-linear ways, and to evaluate forecast performance. The data and our proxies for ex-post realized volatility are

[1] Other time series methods to forecast financial volatility have been suggested. These are: nonparametric, neural networks, genetic programming and models based upon time change and duration. However, it has been found that these have relatively less predictive power and the number of publications using these methods is substantially lower (Poon and Granger, 2003).

[2] For exchange rate over-the-counter option markets investors often trade with implied volatilities. This is why there is hard data available of implied volatilities.

[3] Evidence about the performance of some of these methods for the case of the volatility of the peso–dollar exchange rate, using daily data, can be found in Benavides (2006).