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Forecasting volatility via stock return, range, trading volume and spillover effects: The case of Brazil☆

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ABSTRACT

For the purpose of developing alternative approach for forecasting volatility, we consider heterogeneous VAR (HVAR) model which accommodates the market effects of different horizons, namely, daily, weekly and monthly effects, and examine the interdependence of stock markets in Brazil and the US, based on information of daily return, range and trading volume. To compare with the new approach, we also work with the univariate and multivariate GARCH models with asymmetric effects, trading volumes and fat-tails. The heteroskedasticity-corrected Granger causality tests based on the HVAR show the strong evidence of such spillover effects. We assess the value-at-risk thresholds for Brazil, based on the out-of-sample forecasts of the HVAR model, finding the new approach works satisfactory for the periods including the global financial crisis, without assuming heavy-tailed conditional distributions.

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1. Introduction

After Tauchen and Pitts (1983) proposed the bivariate mixture model, Lamoureux and Lastrapes (1990), Lamoureux and Lastrapes (1994), Andersen (1996) and Liesenfeld (1998), Liesenfeld (2001) among others work with framework for investigating the relationship between stock return volatility and trading volume. Along with the development of modeling latent variables, specifications become complicated. Tauchen and Pitts (1983) assume the log-normal distribution for the latent information arrivals while Lamoureux and Lastrapes (1994), Andersen (1996) and Liesenfeld (1998) employ the AR(1) process for the log of the latent variable. In the class of the 'stochastic volatility' (SV), the latent variables correspond not only the information arrivals but also the unobservable volatility. In Andersen (1996) and Liesenfeld (1998), the estimated measure of volatility persistence drops significantly compared with the univariate specifications for the return volatility. Recently, Liesenfeld (2001) proposes the generalized mixture model and uses two latent AR(1) processes. Fleming, Kirby, and Ostdiek (2006) suggest the use of the sum of the AR(1) model and a white noise for the log of the latent variable, while Asai and Unite (2010) employ the two-factor AR(1) model.

Spillover effects from other markets can be captured by examining the interdependence of these markets. With respect to the relationship between stock returns and volatilities, Lin, Engle, and Ito (1994), Karolyi (1995), Luca, Genton, and Loperfido (2007) among others employed multivariate GARCH models in order to investigate the interdependences between US and other countries, while several papers including Asai and McAleer (2006), Asai and McAleer (2009) and Lopes and Carvalho (2007) work with multivariate SV models. In addition to stock return and volatility, Lee and Rui (2002) investigated the effects of trading volume to other markets.

Instead of multivariate GARCH and SV models for stock returns, we work with range data for the reasons below. The range data of financial returns have been used to estimate volatilities (see e.g., Parkinson, 1980; Yang & Zhang, 2000). The daily range has been also considered as one of the proxies of daily volatility. Gallant, Hsu, and Tauchen (1999) employ daily range to extracting unobservable volatility. Alizadeh, Brandt, and Diebold (2002) developed an approach which decomposes the log-range into log-volatility and noise, in order to estimate stochastic volatility models. Brandt and Jones (2006) extend their idea to develop the range-based EGARCH model, while Asai and Unite (2010) employ the approach in order to estimate several kinds of asymmetric SV models. Chou (2005) developed the conditional autoregressive range models for forecasting volatilities, while Chou (2007) extended it to include asymmetric effects. Recently, Diebold and Yilmaz (2011) employed weekly range for examining return and volatility spillovers to global markets, while Kim (2005) analyzed such interdependences using daily return, range and trading volume. As explained above, the range can be used to modeling conditional and stochastic volatilities, and it can be a proxy of volatility with noise.

Recently, there are growing attentions on realized volatility which is an estimate of volatility based on ultra-high frequency data. See McAleer and Medeiros (2008a) and Barndorff-Nielsen, Hansen, Lunde, and Shephard (2008). However, calculating daily realized volatility still takes high cost in the growing countries. For these countries, range is a noisy but convenient proxy, compared to the realized volatility.

The purposes of the paper are (i) to investigate the interdependences of stock markets in US and Brazil with respect to return, volatility and trading volume, and (ii) to examine out-of-sample volatility forecasts based on such effects. For these purposes, we develop the heterogeneous VAR (HVAR) model which accommodates the market effects of different horizons, namely, daily, weekly and monthly effects. The idea comes from the heterogeneous GARCH model of Müller et al. (1997) and heterogeneous AR model of Corsi (2009). The advantage of the approach is that such model can approximate higher order models with saving the number of parameters. We also work with the heteroskedasticity-corrected tests for Granger causality. It is well-known that tests based on OLS estimates tend to over-reject the null of zero coefficients in the presence of heteroskedasticity. For these purpose, the works of Kim (2005) have rooms to be re-examined. To compare with the new approach, we also consider univariate and multivariate GARCH model with asymmetric effects, trading volumes and fat-tails. Our empirical analysis shows that including the heterogeneous markets effects improves the