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Modelling stock return volatility dynamics in selected African markets

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ABSTRACT

This paper examines whether accounting for structural changes in the conditional variance process, through the use of Markov-switching models, improves estimates and forecasts of stock return volatility over those of the more conventional single-state (G)ARCH models, within and across selected African markets for the period 2002–2012. In the univariate portion of the paper, the performances of various Markov-switching models are tested against a single-state benchmark model through the use of in-sample goodness-of-fit and predictive ability measures. In the multivariate context, the single-state and Markov-switching models are comparatively assessed according to their usefulness in constructing optimal stock portfolios. Accounting for structural breaks in the conditional variance process, conventional GARCH effects remain important in capturing heteroscedasticity. However, those univariate models including a GARCH term perform comparatively poorly when used for forecasting purposes. In the multivariate study, the use of Markov-switching variance–covariance estimates improves risk-adjusted portfolio returns relative to portfolios constructed using the more conventional single-state models. While there is evidence that some Markov-switching models can provide better forecasts and higher risk-adjusted returns than those models which include GARCH effects, the inability of the simpler Markov-switching models to fully capture heteroscedasticity in the data remains problematic.

1. Introduction

Regardless of the many likely causes of stock market volatility (Abel, 1988; Adam et al., 2008; Aggarwal et al., 1999; Diebold and Yilmaz, 2007; Olsen, 1998; Schwert, 1989; Shiller, 1987), a reliable statistical model of stock return volatility is important for the pricing of equity derivative securities and effective hedging of stock market risk (Hamilton and Susmel, 1994; Wang and Theobald, 2008). In addition, changes in the co-movement of stock returns across international markets during high- and low-volatility periods have major implications for diversification strategies (Li, 2009; Ramchand and Susmel, 1998).

A common feature of Generalised Autoregressive Conditional Heteroscedasticity (GARCH)-type models using daily financial data is the high level of persistence attributed to shocks. Many GARCH studies involving financial series have found that an approximate unit root process generates the estimated variance (Engle and Bollerslev, 1986; Susmel, 1999). However, it has been shown that in the presence of structural breaks, GARCH-type models can impose a spuriously high level of persistence of shocks on volatility forecasts (Diebold, 1986; Lamoureux and Lastrapes, 1990; Timmerman, 2000). This finding has led to the parallel development of the Markov-switching ARCH (SWARCH) model, which allows for endogenously identified structural shifts in the volatility generating process (Cai, 1994; Hamilton and Susmel, 1994).

Having controlled for regime shifts, the persistence of shocks on volatility forecasts is generally reduced in a statistically significant way (Cai, 1994; Edwards and Susmel, 2003; Hamilton and Susmel, 1994; Marcucci, 2005; Ramchand and Susmel, 1998). Thus, while volatility clustering is still captured, the regime-switching models allow this clustering to be generated by regime changes in addition to within-regime persistence of shocks. That is, where single-regime GARCH models imply a purely time-varying variance, regime-switching models allow for volatility that is both time-varying and state-varying (Ramchand and Susmel, 1998). This specification can thus offer a more intuitively appealing interpretation of the volatility-clustering phenomenon than the single-regime GARCH models, as well as improve forecasts due to a higher likelihood of stationarity.

It was initially believed that the regime-switching models would in practice have to be restricted to low order SWARCH due to the recursive nature of GARCH models and the resulting intractability of maximum likelihood estimation for studies with large samples (Cai, 1994; Hamilton and Susmel, 1994). However, this estimation problem has been largely addressed by Gray (1996). The use of Gray's (1996) Markov-switching GARCH (MS–GARCH) procedure or it's extensions (Dueker, 1997; Haas et al., 2004; Klaassen, 2002) has allowed richer comparison of parameter estimates across models, as it nests the popular GARCH(1,1) as a special case (Gray, 1996).

Markov-switching models often provide a better in-sample fit of the data or more accurate forecasts than the conventional single-state GARCH extensions (Bollen et al., 2000; Cai, 1994; Canarella and Pollard, 2007; Chen, 2009; Edwards and Susmel, 2001; Gray, 1996;

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