Regime Switching GARCH
(An Application to Dowjones Index Return)

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Abstract

Since firstly proposed by Engle (1982) and Bollerslev (1986), ARCH-GARCH models have been used to describe volatility behaviors of time series, especially in stock market analysis. One of the weaknesses of ARCH-GARCH is its inability to model behavior transition between high volatilities and low volatilities. In this research, markov switching GARCH is investigated and applied to capture the presence of different volatility regimes, i.e. low volatilities regime and high volatility regime in Dowjones index return. However, there is no information to decide which observations belong to each of the regimes, and to account this difficulty, EM algorithm is applied for parameter estimation. The result shows that Dowjones index return includes two volatility regimes. The transition matrix of the model yields that low volatility regime is often happened than the high one.

Keywords : GARCH, Markov Chain, Switching model, Mixture Normal, EM-Algorithm.

1. INTRODUCTION

Over past ten years since it has been proposed by Engle (1982, *Econometrica*, 50, 987-1001) and Bollerslev (1986, *Journal of Econometrics*, 31, 307-327), ARCH and GARCH were known as advance and accurate methods to describe the volatility behavior of asset's return data. However, considering the transition between the change of low volatility and high volatility regimes, common GARCH model needs to be developed to capture such regime switching. Proposed firstly by Hamilton (1989, *Econometrica*,57, 357-384), regime switching time series model has been developed to analyze such jumps between regimes and then followed by regime switching ARCH as in Hamilton (1994, *Journal of Econometrics*, 64, 307-333). Finally, Gray (1996, *Journal of Financial Economics*, 42, 27-62) has succeeded to implement regime switching GARCH to weekly Treasure Bill rates data, and followed by Marcucci (2005, *Studies in Nonlinear Dynamics & Econometrics*, 9, issue 4) with t-student and generalized error innovations included in model.

2. REGIME SWITCHING GARCH

The main feature of regime switching models is the possibility for some, or all, the parameter to switch across different regimes according to a Markov chain process, governed by unobservable state variable S_t, with transition probability

$$\Pr\left(S_t = j \middle| S_{t-1} = i\right) = p_{ij}, \qquad i,j = 1,2 \tag{1}$$

and transition matrix