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The Tunisian stock market index volatility: Long memory vs. switching regime

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A B S T R A C T

This paper investigates the dilemma of long memory versus a switching regime for the Tunisian stock market index volatility. Precisely, different specifications of the Fractionally Integrated GARCH (FIGARCH) model of Baillie et al. (1996) and Switching ARCH (SWARCH) model of Hamilton and Susmel (1994) have been estimated under both Gaussian and Student error distributions.

The empirical results show that the Student FIGARCH(1,d,1) specification outperforms the Markov switching ARCH model. In addition, the empirical results indicate that the long memory behavior observed in the Tunisian stock price (TUNINDEX) volatility is a true behavior and is not spuriously created by changes in regimes.

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1. Introduction

Modeling stock market volatility has been one of the most important areas of research in empirical finance and time series econometrics for several reasons. First, from a financial perspective, correct specification of volatility evolution has important implications for investors' decisions and effective portfolio diversification because it is a key input for assets and derivative pricing, portfolio allocation, and risk measurement. Second, from a statistical perspective, inferences concerning the conditional mean of a variable require correct specification of its conditional variance. Thus, the investigation of the statistical properties of stock return volatility remains a notably interesting, relevant and hotly debated topic.

Of the abundance of literature on volatility, the vast majority of papers use variants of the GARCH family of stochastic processes, which provide an easy and convenient means of capturing the basic

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autoregressive structure of conditional variances. However, the results are not unanimously in favor of GARCH models at least when applied to low-frequency (daily, weekly) data. In this regard, the long memory issue is intriguing because of its important implications for capital market theories. In particular, the presence of long memory in stock market volatility elucidates the higher-order correlation structure of a financial time series and supports the possibility of predicting of behavior of these series in a market setting. The presence of long memory in returns and volatility implies that dependencies between distant observations exist. That is, long memory in these series is associated with the high autocorrelation function, which decays hyperbolically and eventually disappears.

The most compelling motivation for the use of long memory is that it implies the long-run effects of shocks compared to conventional approaches. In addition, this approach has important implications in describing the correlation structure of a time series with long lags when the time series are characterized by irregular cyclical fluctuations. The use of a long-memory model has been largely approved for the squared returns and power transformation of absolute returns and other measures of volatility of financial time series (see for instance, Baillie et al., 1996; Breidt et al., 1998; Davidson, 2004; Harvey, 1998; Kumar, 2012). To account for this high persistence behavior, several models have been introduced in the empirical literature such as the Integrated GARCH, Fractional Integrated GARCH and component GARCH (see Baillie et al., 1996; Ding and Granger, 1996; Engle and Bollerslev, 1986). The FIGARCH model of Baillie et al. (1996) extends the GARCH model of Bollerslev (1986) to long memory by allowing the long memory parameter to lie between 0 and 1 and hence offers high potential for modeling financial time series compared to the IGARCH and component GARCH model. In the empirical literature, FIGARCH models have been largely applied to several forms of economic and financial data, such as stock returns, exchange rates and inflations rates (see Andersen et al., 2003; Baillie et al., 1996; Bellalah et al., 2005; Bollerslev and Mikkelsen, 1996; Conrad et al., 2011 among many others).

However, another possible explanation for long memory is the presence of structural breaks in financial time series. In other words, discovery of a long memory compound might be the consequence of unaccounted structural breaks. For example, Lamoureux and Lastrapes (1990) found that the presence of long memory is greatly reduced when allowing for structural shifts. Along this line, Granger and Teräsvirta (1999) found that simple regime-switching processes with short memory can easily give rise to spurious findings of fractional integration. Recent studies in this area suggest that several nonlinear models exhibit or approximate long-memory. In most cases, the model incorporates a form of regime switching between states (see for instance, Charfeddine and Guegan, 2011, 2012; Diebold and Inoue, 2001; Gourieroux and Jasiak, 2001; Granger and Hyung, 2004; Granger and Teräsvirta, 1999; Liu, 2000; Mikosch and Starica, 2003; Yalama and Celik, 2013).

In this way, an alternative approach to modeling stock returns is to assume that variance changes between states or regimes. One of the most important processes used for modeling stock market volatility is the Markov switching regime model with the ARCH(q) process under each regime (SWARCH model), which considers the presence of structural changes (see for instance, Hamilton and Susmel, 1994; Susmel, 2000). Under the SWARCH model, volatility depends on past news and the state of the stock market. Moreover, the long-run dynamics within each regime are governed by regime shifts in unconditional variance according to a first-order Markov-switching process. The short-run dynamics are governed by an ARCH process.

In this paper, we aim to investigate whether Tunisian stock market data are characterized by a true or spurious long-memory behavior. This dilemma of long memory vs. a switching regime motivates us to investigate the case of the Tunisian stock market for many reasons: (i) to the best of our knowledge, this paper is the first to relate to an Arabic country to study the dilemma of long memory vs. a switching regime in volatility, and (ii) the lack of institutional development and corporate governance, the low volume of trading on the market and market microstructure distortions make the Tunisian stock market an interesting case of study (see Bellalah et al., 2005). These factors hinder the flow of information to market participants. Consequently, estimation results have important implications for our understanding of the properties of the Tunisian stock market and other frontier and emerging markets to which the Tunisian stock market has a comparable degree of financial development (e.g., certain North Africa and Middle Eastern countries).

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