Available online at www.sciencedirect.com
ScienceDirect
Int. Fin. Markets, Inst. and Money 18 (2008) 305–312
Journal of INTERNATIONAL FINANCIAL MARKETS, INSTITUTIONS & MONEY
www.elsevier.com/locate/intfin

Long memory in the volatility of an emerging equity market: The case of Turkey

Robert DiSario [a,✠], Hakan Saraoglu [b,*], Joseph McCarthy [b,1], Hsi Li [b,2]

[a] *Department of Mathematics, Bryant University, 1150 Douglas Pike, Smithfield, RI 02917-1284, United States*
[b] *Department of Finance, Bryant University, 1150 Douglas Pike, Smithfield, RI 02917-1284, United States*

Received 21 February 2006; received in revised form 2 January 2007; accepted 29 January 2007
Available online 2 February 2007

Abstract

We use methods based on wavelets and aggregate series, which have gained growing acceptance in the finance literature, to test for long memory in the absolute value, squared, and log squared daily returns of the Istanbul Stock Exchange National 100 Index. Our results show that all three volatility series are characterized by long memory, indicating that shocks to the stock index volatility decay slowly and that distant observations of the series are associated with each other. There are several implications of our study for further research. First, models examining the volatility of the Turkish equity returns should include a long memory component in their parameter set. Second, tests should be conducted to assess whether such models result in an improvement in the volatility forecasts of the Turkish equity returns.

JEL classification: C14; C22; G15

Keywords: Wavelets; Long memory; Emerging markets

1. Introduction

The equity markets of emerging economies have enjoyed rapid and substantial growth in the past couple of decades as investors seeking high return prospects and diversification benefits

* Corresponding author. Tel.: +1 401 232 6450; fax: +1 401 232 6319.
E-mail addresses: saraoglu@bryant.edu (H. Saraoglu), mccarthy@bryant.edu (J. McCarthy), hli@bryant.edu (H. Li).
✠ Passed away on December 31, 2005.
[1] Tel.: +1 401 232 6446; fax: +1 401 232 6319.
[2] Tel.: +1 401 232 6079; fax: +1 401 232 6319.

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doi:10.1016/j.intfin.2007.01.001

channeled their funds to assets in these markets. These developments have prompted financial economists to study various aspects of stock return behavior in the emerging markets. Wright (2001) examined stock returns in several emerging economies, and found evidence of long memory in stock returns in seven of these markets. Assaf and Cavalcante (2005) found long memory in the absolute, squared, and log squared returns in the Brazilian stock market. Barkoulas et al. (2000) reported significant and robust evidence of positive long-term persistence in the Greek stock market. Using a fractional autoregressive integrated moving average (FARIMA) model, Panas (2001) also demonstrated the existence of long memory in individual stock returns in the Athens Stock Exchange.

Turkey, which is considered an emerging market, has seen significant growth in its equity market since the inception of the Istanbul Stock Exchange (ISE) in 1986. As is the case in most emerging economies, investors face high risks in the Turkish equity market. Further development of the equity market in Turkey and its integration with world capital markets are dependent on the ability of the investors to assess the risks they face. Given these facts, it is essential to examine the volatility behavior of equity returns in Turkey. In a recent paper, Kilic (2004) uses both parametric and nonparametric methods to demonstrate long memory in the volatility of the daily returns of the Istanbul Stock Exchange National 100 Index (ISE National-100). In this study, we use wavelets and aggregate series, which are recently becoming popular in the finance literature, to test for long memory in the absolute value, squared, and log squared daily returns of the ISE National-100. The existence of long-memory in the volatility of stock returns implies that the volatility series demonstrate autocorrelation and future volatility can potentially be predicted using past volatility observations. This has risk management implications in the emerging market of Turkey. We provide a review of the volatility measures and describe our data in the next section. Section 3 includes a discussion of long memory in time series. We present the methods and results of our analysis in Section 4, and discuss the future research implications of our findings in Section 5.

2. Measures of return volatility

In our analysis, we use the daily closing values of the ISE National-100 for the period of July 1988–May 2004. We calculate the daily return, r_t, of the ISE National-100 as follows:

$$r_t = \ln p_t - \ln p_{t-1}, \tag{1}$$

where p_t denotes the value of the index on day t. We focus on squared daily returns, r_t^2, absolute value daily returns, $|r_t|$, and log squared daily returns, $\ln r_t^2$, as proxies for the volatility of the ISE National-100. We standardize these volatility series prior to further analysis. Each of the three series contains 4096 observations. The logarithm of squared returns is problematic when the returns are zero or very small in magnitude. In order to get around this problem, we utilize a transformation proposed by Fuller (1996), which is defined by the following equation:

$$y_t' = \ln(r_t^2 + \lambda s^2) - \frac{\lambda s^2}{r_t^2 + \lambda s^2}, \tag{2}$$

where λ is a small constant, which is selected subjectively, s^2 denotes the sample variance of the daily returns, and $y_t = \ln r_t^2$. Following a similar analysis by Ray and Tsay (2000), we assign a value of 0.02 to λ.