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Nonlinear serial dependence and the weak-form efficiency of Asian emerging stock markets

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Abstract

The objective of this paper is to re-examine the weak-form efficiency of 10 Asian emerging stock markets. Using a battery of nonlinearity tests, the statistical results reveal that all the returns series still contain predictable nonlinearities even after removing linear serial correlation from the data. The next stage of sub-sample analysis using the Hinich [Hinich, M., 1996. Testing for dependence in the input to a linear time series model. Journal of Nonparametric Statistics 6, 205–221] bicorrelation test shows that the 10 Asian series follow a pure noise process for long periods of time, only to be interspersed with brief periods of strong nonlinear dependence. The exploratory investigation found that the cross-country differences in nonlinear departure from market efficiency can be explained by market size and trading activity, while the transient burst of nonlinear periods in each individual market can be attributed largely to the occurrence of economic and political events.
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1. Introduction

In the voluminous literature on the weak-form efficient market hypothesis (EMH), the unpredictability of security returns from past returns has become the most commonly tested criterion in

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empirical studies.[1] However, these short-horizons return predictability studies (commonly known as conventional efficiency studies) have been widely criticized for their focus on linear correlations of price changes. First of all, it is well established in the literature that thin trading would induce spurious autocorrelation in stock returns that is not genuine predictability, but rather a statistical illusion. Another potential source of bias is the imposition of price limits by stock exchanges. Though a number of studies have proposed some adjustment procedures, there is always a concern that the effects of these trading frictions would be underestimated. Since one can never be sure on the degree of these spurious autocorrelations, Hong and Lee (2005) argued that an alternative approach would be to remove all linear serial correlation from the data and determine whether stock returns still contain predictable nonlinearities.

The second criticism launched against the conventional efficiency studies is that a white noise process does not necessarily imply efficiency as returns series can be linearly uncorrelated and at the same time nonlinearly dependent. This was highlighted 24 years ago by Granger (1983) in his appropriately titled "Forecasting white noise", in which the author demonstrated that one could never be sure that a time series with zero autocorrelation is not forecastable. The same decade also witnessed the development of some nonlinear tools that led to subsequent uncovering of hidden nonlinear serial dependency structures in earlier observed random stock market data (see Hinich and Patterson, 1985; Hsieh, 1991). This piece of evidence suggests the potential of predictability, and prompted researchers to re-examine the weak-form market efficiency using statistical tests that are capable of detecting nonlinear patterns in financial time series (for some recent studies, see Panagiotidis, 2005; Saadi et al., 2006).

The present paper straddles different strands of studies in the huge return predictability literature in three significant ways. Firstly, this study applies a battery of nonlinearity tests outlined in Patterson and Ashley (2000) to a broader set of emerging Asian stock markets in order to determine whether or not nonlinearity exists in the full sample of the returns series. Secondly, conventional efficiency studies commonly assume market efficiency is a static characteristic that remains unchanged over different stages of market development. However, the statistical findings of inefficiency in the full sample could have masked those periods when market is indeed efficient and vice versa. Motivated by this concern, a number of recent papers have shifted from the traditional focus of absolute market efficiency to tracking the changing degree of efficiency over time in emerging stock markets (see, for example, Rockinger and Urga, 2000; Cajueiro and Tabak, 2006). Using the autocorrelation coefficient (short-term linear dependence) or Hurst exponent (long-term linear dependence) as indicators of market efficiency, the time-varying framework permits the above studies to identify when and speculate why market inefficiency occurs in a particular stock market.[2] Following this group of emerging studies, the subsequent analysis further examines whether the detected nonlinear dependency structures in the emerging Asian returns series, if any, are localized in time (see Ammermann and Patterson, 2003). The research framework employed was originally proposed by Hinich and Patterson (1995), in which the full sample

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[1] Methodologically, the serial correlation tests, runs test, variance ratio tests and unit root tests are the common statistical tools employed (some recent studies include Al-Khazali et al., 2007; Hoque et al., in press).

[2] Rockinger and Urga (2000, p. 458) argued that this approach appears to be the only way of measuring whether market efficiency has increased since there is no observable variable for emerging markets that might be used to quantify improvements in stock market efficiency. Nevertheless, this framework was also adopted for the developed US stock market by Gu and Finnerty (2002), who found that the Dow Jones Industrial Average has slowly evolved towards efficiency in the last 103 years (see also Chordia et al., 2005 for the speed of convergence to weak-form efficiency using intraday data for stocks listed on the New York Stock Exchange).