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Common stochastic trends and volatility in Asian-Pacific equity markets

Ming-Shiun Pan[a,*], Y. Angela Liu[b], Herbert J. Roth[a]

[a]*Department of Finance, Decision Sciences, and Information Systems, Shippensburg University, Shippensburg, PA, 17257, USA*
[b]*Department of Business Administration, National Chung Cheng University, Chia-Yi 226, Taiwan, Republic of China*

Abstract

This paper uses Johansen's cointegration test and a modified cointegration test with generalized autoregressive conditional heteroskedasticity (GARCH) effects to examine linkages between the U.S. and five Asian-Pacific stock markets (Australia, Hong Kong, Japan, Malaysia, and Singapore) during the period from 1988 to 1994. The modified cointegration test with GARCH effects is used to assess whether these stock price series share common time-varying volatility. The results indicate that the six stock markets are highly integrated through the second moments of stock returns but not the first moments.

JEL classification: F36; G15

Keywords: Asian pacific equity markets; GARCH; Cointegration; Time-varying volatility

Interest in integrations of international equity markets has led to a considerable amount of work in this area. Studies by Panton, Lessig, and Joy (1976), Hilliard (1979), Fischer and Palasvirta (1990), and Ko and Lee (1991) focus on investigating the degree of correlation and causality across international stock markets. Whereas earlier studies find low correlation among national stock returns, results from more recent studies (Eun & Shim, 1989; Arshanapalli & Doukas, 1993) seem to indicate that interdependence between international equity markets has increased, particularly since the October 1987 stock market crash.

This paper is related to the growing literature on stock markets' integration. Recent works have focused their attention on analyzing whether international stock markets

* Corresponding author.

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have common long-run stochastic trends. For instance, Chan, Gup, and Pan (1992) and DeFusco, Geppert, and Tsetsekos (1996) examine the temporal relation between Asian-Pacific stock markets and show that the stock market indexes are not cointegrated. Arshanapalli and Doukas (1993), however, find that cointegration exists in a set of major stock markets. Unlike that of previous research, the focus of this study is to investigate the volatility process of national stock market indexes. Several studies [see, e.g., Hamao, Masulis, and Ng (1990), King and Wadhwani (1990), and Theodossiou and Lee (1993)] examined how news from one international market influences other markets' volatility process. These works provide evidence of volatility spillovers between international stock markets. This study builds on the burgeoning literature that uses time series techniques to determine whether international stock markets have the same volatility process. More specifically, the modified cointegration test with generalized autoregressive conditional heteroskedasticity (GARCH) effects presented in Gannon (1996) is used to address the matter of common time-varying variance across national stock market indexes. This new econometric method is tractable in the sense that it permits investigation of comovement in the second moments.

The focus of this paper is threefold. First, a test for a common stochastic trend in the national stock market indexes is conducted. Second, the paper investigates whether national stock markets are characterized by time-varying volatility and are interdependent through their second moments of stock returns. Third, this study takes advantage of the time-varying conditional volatility to test for common volatility among the national stock market indexes.

The rest of the paper is organized as follows. The next section outlines Johansen's multivariate cointegration test (Johansen, 1988) and describes the modified cointegration analysis for testing whether national stock market indexes have a common general autoregressive conditional heteroskedasticity (common-GARCH) feature. Section 2 describes the data employed in this study and presents the empirical results. The conclusion is in the last section.

1. Testing methodology

1.1. Cointegration in first moments

Cointegration of a vector of variables (e.g., stock price indexes) implies that the number of unit roots in the system is less than the number of unit roots in the corresponding univariate series. The statistical idea of the concept of cointegration, developed by Engle and Granger (1987), is that some linear combination of two or more series is stationary [i.e., $I(0)$] even when each of the series individually is nonstationary [i.e., $I(1)$]. Cointegration means that, although many developments can cause permanent changes in each of the individual series, there is some long-run equilibrium relation tying the individual series together. For example, when analyzing linkages between international stock markets, it is of interest to determine if there are any common forces driving the long-run movement of the data series or if each individual stock index is driven solely by its own fundamentals.