

# The extreme-value dependence of Asia-Pacific equity markets

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Received 4 October 2006; accepted 15 August 2007

Available online 30 August 2007

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## Abstract

In this paper we study the dependence structure of extreme realization of returns between seven Asia-Pacific stock markets and the U.S. Methodologically we apply the multivariate extreme value theory that best suits to the problem under investigation. The evidence we obtain indicates that extreme correlations are not substantially different from the unconditional ones or from those obtained from multivariate GARCH models. A clustering analysis shows that the Asia-Pacific countries do not belong to a distinct block of countries on the basis of the extreme correlations we have estimated. The policy implications of our study are that the benefits from portfolio diversification with assets from the Asia-Pacific stock markets are not eroded during crisis periods, in the sense that no correlation breakdown has been observed.

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*JEL classification:* G15; C10; F30

*Keywords:* Extreme-value dependence; Asia-Pacific emerging markets; Multivariate GARCH

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## 1. Introduction

The discussion of the most appropriate methodology to use for the estimation of the dependence structure between two markets, under extreme circumstances, converges on the choice of the most general data generating process for the tails of the distribution. In this paper we rely on the multivariate extreme value theory (MEVT) in order to calculate extreme correlations, for

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both the right and left tail returns, among seven Asia-Pacific equity markets and the U.S. In the literature on contagion, statistically different measures of dependence for the right and left tails imply a different degree of association of financial asset returns depending on the sign of the shocks. Our paper resembles methodologically the paper by Longin and Solnik (2001), although here the focus is not on testing for the validity of the multivariate normal distribution for the extreme returns but rather on the classification of the Asian markets into low, medium and high risk groups on the basis of the estimated conditional extreme correlations. In other words we attempt to answer the question whether the contagion of financial crises is more or less the same for the seven Asia-Pacific countries. We are also able to provide some fresh evidence on the issue of correlation breakdown through the comparison of the extreme correlations with the conditional and unconditional ones. We believe that this line of research is of particular interest to international portfolio managers who systematically monitor correlations between various stock markets and the success of their policies is intimately linked to the stability of the estimated correlations they are based on.

It has been widely documented in many empirical studies that equity markets around the world exhibit a higher correlation during periods of crises. Although this is hardly disputed empirical evidence, there is a rising controversy on the economic interpretation that should be given to it. Since the seminal paper by King and Wadhvani (1990), changes in the correlation coefficient of financial asset returns have been associated with the notion of contagion. This term refers to the spread of downside market shocks from one country to another and it can be explained from the existence of real and financial linkages between the countries or the behavior, rational and irrational, of international investors.<sup>1</sup> However, before one proceeds with the explanations that have been offered to the correlation breakdown issue, there must be an agreement that this breakdown has really occurred.

The econometric investigation of the stability of the correlation coefficient has proven to be an obscure issue and recent research in this area has highlighted two major problems. First, the choice of “conditioning” the correlation index on periods of high volatility is not the appropriate one if we intend to test for a correlation breakdown. Many recent studies have shown that in this case we get biased estimates of the true correlation. Boyer et al. (1999) show how the correlation breakdown is generated, when conditioning on realizations of one variable, for the cases of a pair of bivariate normal random variables and of a bivariate GARCH(1,1) process with a constant contemporaneous correlation coefficient. Loretan and English (2000) computed adjusted, for the effect of volatility, correlation coefficients between daily returns on the UK FTSE 100 and the German DAX stock indices and they derived no evidence of a structural change during the Mexican crisis in 1994. Forbes and Rigobon (2002) studied the correlation between Mexico and 28 other countries and showed that when the correlation is adjusted for shifts in the variances less than 5% of the cases, traditionally classified in the group exhibiting contagion, still presented significant correlation changes. Rigobon (2003) shows that the adjustment of the correlation coefficients is biased when the data on stock market returns suffers, except for heteroscedasticity, from simultaneous equations and omitted variables problems. He then applies a new methodology that allows one to test for the stability of the transmission mechanism, taking into account all three predicaments. In his study that covers 36 stock markets during the last three major financial crises (Mexico 1994, Asia 1997, Russia 1998) in less than 10% of the cases does the transmission mechanism change.

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<sup>1</sup> See Karolyi (2003) for a survey on this issue.

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