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Dynamic spanning trees in stock market networks: The case of Asia-Pacific☆

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HIGHLIGHTS

- We propose a new procedure called Dynamic Spanning Trees (DST).
- Stock market inter-connectedness in the Asia-Pacific region is analyzed.
- The DST significantly shrinks over time.
- Hong Kong is found to be the key financial market.
- DST has a significantly increased stability in the last few years.

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ABSTRACT

This article proposes a new procedure to evaluate Asia Pacific stock market interconnections using a dynamic setting. Dynamic spanning trees (DST) are constructed using an ARMA–FIEGARCH–cDCC process. The main results show that: 1. the DST significantly shrinks over time; 2. Hong Kong is found to be the key financial market; 3. the DST has a significantly increased stability in the last few years; 4. the removal of the key player has two effects: there is no clear key market any longer and the stability of the DST significantly decreases. These results are important for the design of policies that help develop stock markets and for academics and practitioners.

1. Introduction

Financial markets around the world can be regarded as a complex system. This forces us to focus on a global-level description to analyze the interaction structure among markets which can be achieved by representing the system as a network. Correlation between stock markets plays a central role in investment theory and risk management, and also are key elements for the optimization problem in the Markowitz [1] portfolio theory. Thus, a correlation based network could be very useful in analyzing the interactions between financial markets and building optimal investment strategy.

During recent years, networks have proven to be a very efficient way to characterize and investigate a wide range of complex financial systems including stock, bond, commodity and foreign exchange markets.[1] In this study, we are interested

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[1] For the frontier studies, see Refs. [2–26].

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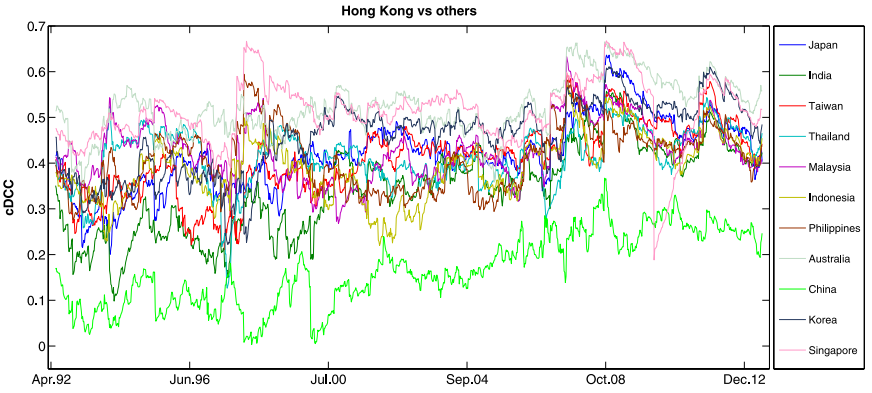

Fig. 1. Dynamic correlations between Hong Kong and other Asia-Pacific stock markets revealing the decreased diversification benefits across the region due to the increased correlations.

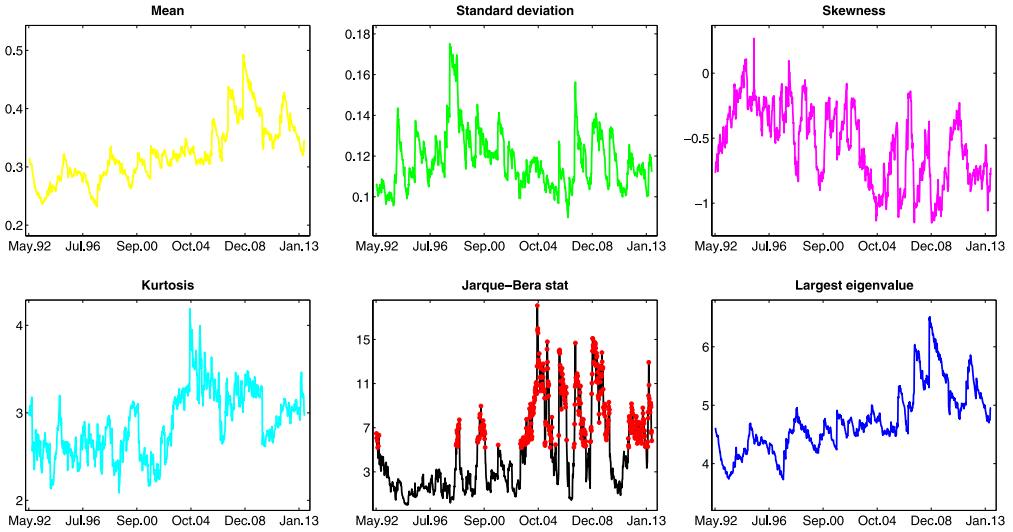

Fig. 2. Time-varying fundamental statistics of the dynamic correlation matrix (red points in the Jarque–Bera stats denote the rejection of normality at a 5% significance level).

in analyzing the connection structure of Asia-Pacific stock market network formed with correlations of returns in the last two decades. In order to do that, we construct the minimal spanning tree (MST) by the metric introduced by Mantegna [2]. However, it is a well known fact that correlations tend to vary over time. To capture this fact, we use the consistent dynamic conditional correlation model of Ref. [27]. By this way, we also consider the problem of the stability associated with the minimal spanning tree (MST) obtained from price returns.

Although similar analyses have been performed on several stock markets in the Econophysics literature, surprisingly Asia-Pacific received no attention considering the importance of the region in the world financial system.[2] Moreover, such an analysis is particularly interesting in understanding the interaction of different types of economies since the region covers a variety of them: it includes developed economies such as Australia and Japan, the export-led growth Asian tigers of Hong Kong, South Korea, Singapore and Taiwan as well as emerging economies such as India and Thailand. The countries within the region also display varying degrees of barriers to capital flows with Hong Kong displaying virtually none and China and Malaysia some formal capital controls. In this paper, we intend to fill the existing gap in the literature.[3]

The analysis shows that the DST shrinks significantly over time (in particular, in times of the 1997 Asian financial crisis and the 2008 global financial crisis) suggesting an increase in the interdependence among the Asia-Pacific markets over the past two decades. Using several tools from network theory, we reveal that Hong Kong is clearly the key market in the region

2 However, there are some studies partly covering many of the indexes investigated in this manuscript. For example, see Ref. [28].

3 For recent studies analyzing the interconnectivity and transmission mechanisms among the region's stock markets without using network theory, see Refs. [29,30].