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Correlation structure and dynamics of international real estate securities markets: A network perspective

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HIGHLIGHTS

- Correlation structure of international real estate securities markets is studied from a network view.
- MST, HT, and PMFG networks are constructed to analyze the correlation structure.
- Clustering structure, hierarchical structure, and community structure are investigated.
- National markets are linked together according to their geographical distributions.
- Time-varying MSTs and PMFGs are built to analyze dynamics of correlation structure.

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ABSTRACT

In this paper, we investigate the correlation structure and dynamics of international real estate securities markets by using daily returns of 20 national markets during the period 2006–2012 from a network perspective. We construct the minimum spanning tree (MST), the hierarchical tree (HT), and the planar maximally filtered graph (PMFG) obtained from the correlation matrix computed by the daily returns during the investigated period, and analyze the corresponding clustering structure, hierarchical structure, and community structure. We also build the time-varying MST and PMFG networks by a rolling window to examine the dynamics of correlation structure. The empirical results show that (1) the distribution of correlation coefficients is asymmetric, fat-tailed, and non-Gaussian. (2) The distributions of the influence-strength of the MST and PMFG networks obey a power-law. (3) Two clusters (i.e., the European and Asia-Pacific clusters) are found in the MST network, three hierarchical clusters (i.e., two like in the MST and the North American cluster) in the HT, and three communities in the PMFG network, which shows that national markets are linked together according to their geographical distributions. (4) The descriptive statistics of correlation coefficients and distances of the MSTs and PMFGs are time-varying; especially during periods of crisis they have a large fluctuation. (5) A huge number of linkages between national markets survive from one time to the next, and the long-term stability of the correlation structure in international real estate securities markets descends as time goes on. Our obtained results are new insights in international real estate securities markets and have wide applications for investment portfolio and risk management.

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1. Introduction

Since the pioneering work of the mean–variance model proposed by Markowitz [1], the correlation structure of financial assets has been unceasingly a topic of widespread studies both in academic and industrial areas. It is crucial information not only for understanding and describing the interaction behavior of complex financial systems but also for financial activities ranging from asset allocation and investment portfolio to risk management [2]. There is a huge body of literature on investigating the correlation structure of assets in financial markets, such as stock markets [3–6], foreign exchange markets [7–9], and international equity markets [10,11]. Furthermore, a high percentage of the literature concentrates on the study of correlation structure of international real estate securities markets (see, e.g., a review by Worzala and Sirmans [12] and references therein). More recently, many different methods are applied to quantify the correlation structure among different real estate securities markets. For instance, Liow and Sim [13] investigate the unconditional correlations between US and the Asian real estate securities markets in the period from 1990 to 2003 through analyzing the correlation matrix based on Pearson's correlation function (PCC). Michayluk et al. [14] design an asymmetric covariance model to analyze the time-varying correlations between US and UK securitized real estate markets in the period 2000–2003, while Goorah [15] uses copula methods to examine the correlation structure between the two real estate securities markets during the period 1990–2007. Liow et al. [16] employ the dynamic conditional correlation (DCC)-GJR-GARCH model to study the correlation structure and dynamics of international real estate securities markets including five developed markets (US, UK, Japan, Hong Kong, and Singapore). Case et al. [17] analyze the correlation dynamics between US publicly traded real estate investment trusts (REITs) stocks and non-REITs stocks based on the DCC-GARCH model. Zhou and Gao [18] utilize the symmetrized Joe–Clayton (SJC) copula to research the correlations (tail dependences) in international real estate securities markets, namely correlations among six major global markets (US, UK, Japan, Australia, Hong Kong, and Singapore). Zhou [19] applies a wavelet method to investigate correlations among seven major global REIT markets (US, UK, Australia, France, Japan, Hong Kong, and Singapore) at different time scales. Hoesli and Reka [20] study the correlation structure of three securitized real estate markets (US, UK, and Australia) during the period 1990–2010 by employing the asymmetric t-BEKK model and the time-varying SJC copula method. In summary, with the aid of some sophisticated approaches (e.g., PCC, DCC-GARCH, copulas, and wavelet), the most recent studies examine the static and dynamic properties of correlation structure of international real estate securities markets and find that the correlation structure is time-varying.

Although many new developments on the correlation structure of international real estate securities markets are well-documented in the existing literature, we can find two ignored points in previous works as follows. Firstly, in previous studies, every time people only consider and investigate the correlation structure between two real estate securities markets, while ignore the case of multiple pairs of real estate securities markets at the same time. Secondly, the existing literature only takes into account several major real estate securities markets (e.g., US, UK, and Hong Kong); however, it does not consider all potential members of international real estate securities markets including the developed and developing markets. That is to say, to better understand and describe the correlation structure of international real estate securities markets, more real estate securities markets containing major and minor markets should be considered in the research. This is because (1) financial markets (e.g., international real estate securities markets) are well-defined complex systems with a mass of interacting agents [21,22]. (2) Market participants (e.g., investors and hedgers) need to capture the information on the correlation structure of international real estate securities markets as much as possible, which can be helpful for their asset allocation and investment portfolio. In other words, an investor or a hedger has to take into account correlations (co-movements) of each real estate security market with all other real estate securities markets. Specially, the investor or hedger intends to form clusters made up of different real estate securities markets that display similar fluctuations of their prices. However, approaches in the current literature of real estate securities markets cannot improve and address the drawbacks.

Therefore, the purpose of this paper is to overcome the aforementioned limitations in the existing literature from a network point of view. Concretely, our work contributes to the literature by uncovering the correlation structure and dynamics of international real estate securities markets with the correlation network-based methods.[1] The motivations that lead us to choose the correlation network-based methods to investigate the correlation structure of international real estate securities markets are shown as follows. On the one hand, complex network theory has been extensively developed and applied in financial markets to construct financial networks by the correlation network-based approaches (see, e.g., Refs. [5,27–29]). The correlation network-based methods can be used to describe and analyze the relationships among different financial entries in the complex financial systems. In practical terms, the financial network is construed by the correlation coefficients between any two financial assets, where a vertex in the financial network stands for a financial asset and an edge between two vertexes refers to the correlation between the two financial assets. On the other hand, to the best of our knowledge, there is no literature that reports the correlation structure of international real estate securities markets by using the correlation network-based approaches. Therefore, our work is the first that investigates the correlation structure and dynamics of international real estate securities markets from the perspective of network.

[1] In Econophysics, apart from the correlation network-based methods, some other famous and powerful tools are developed to investigate the (cross-) correlation structure among financial assets, such as random matrix theory [23,24], detrended cross-correlation analysis (DCCA) method [25], and multifractal DCCA method [26].