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## An empirical analysis of information transmission mechanism and the trilateral relationship among the Mainland China, Hong Kong, and Taiwan stock markets

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### ABSTRACT

With rapid economic development over the last few decades, Mainland China has emerged as a crucial role in the global markets. One might wonder whether Mainland China could serve as an international center and exhibit significant influences over the neighboring markets. Particularly, the Hong Kong and Taiwan markets, being geographically near and culturally close to China, are supposed to be deeply influenced. Utilizing trivariate BEKK (Baba, Engle, Kraft, and Kroner)-GARCH (Generalized Auto Regressive Conditional Heteroskedasticity) modes, the study attempts to investigate the trilateral relationship among these markets during the 2000–2012 period from the perspective of information transmission. The findings indicate that the Mainland China stock market significantly affected the Hong Kong and Taiwan markets through volatility spillover effects during the sample period. Accordingly, the Mainland China stock market is found to play a leading role in information transmission. Moreover, this study utilizes the BEKK-GARCH model to depict conditional variances and dynamic correlations among these markets. The evidence implies that these markets are closely linked and gradually integrated.

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### 1. Introduction

With a growing integration of global markets, the interaction of international capital markets has drawn the attention of numerous researchers. In view of the importance of information (Allen, 1990; Grossman & Stiglitz, 1980; Kihlstrom, 1974; Radner & Stiglitz, 1984), related studies tend to focus on how information is transmitted between international markets (Engle & Susmel, 1993; Hamao, Masulis, & Ng, 1990; Karolyi, 1995; Kim & Rui, 1999; Koutmos & Booth, 1995; Lin, Engle, & Ito, 1994; Wong, Chau, & Yiu, 2007). The information transmission mechanism mainly consists of two channels: return transmission (Malkiel & Fama, 1970) and volatility spillovers (Kyle, 1985; Ross, 1989). Although many empirical studies have investigated information transmission mechanisms in developed countries (Hamao et al., 1990; Karolyi, 1995), little attention has been paid to emerging markets.

This study aims to re-examine the trilateral relationship among the Mainland China, Hong Kong, and Taiwan stock markets, because

these markets have gone through significant changes in the past decade. For example, China has experienced amazing economic growth with annual average growth rates above 9% since 2002 (source: the United Nations Statistics Division). The influences of the financial markets in Mainland China should not be ignored. One might wonder whether the Mainland China market would work as an international center like the US market. Moreover, these markets have gone through several global financial crises since 2000, including the 2007 subprime mortgage crisis, the 2008 financial tsunami, and the 2010 European sovereign debt crisis. It is interesting to have a retrospective comparison among these stock markets.

The international center hypothesis suggests that the Mainland China market should play a leading role in the transmission of information (Cheung & Mak, 1992; Eun & Shim, 1989). Because Taiwan and Hong Kong are geographically near and culturally close to China, both of them are supposed to be influenced by Mainland China. In contrast, the home bias hypothesis implies that the market information primarily flows from a domestic market to the external markets. As such, influences of domestic markets should dominate those of foreign markets. The home bias effect might come from the superior information of domestic investors over that of foreign investors. Accordingly, the Taiwan or Hong Kong stock market should be influenced more significantly by domestic market information than by information from Mainland China.

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The geographic proximity and homogenous culture among the Taiwan, Hong Kong, and Mainland China stock markets help information flow smoothly among these markets. Therefore, information transmission among these markets should work more efficiently. However, prior studies have documented controversial evidence. For example, [Chakravarty, Sarkar, and Wu \(1998\)](#) found that there is little relation between the China and Hong Kong stock markets. Likewise, using a restricted VAR (Vector autoregression) model as well as the Bernanke-Sims decomposition to compute the impulse response, [Wu and Lin \(2003\)](#) found that Chinese stock markets are weakly linked to the markets in Taiwan and Hong Kong. In contrast, [Lam and Qiao \(2009\)](#) used nonlinear Granger causality tests to study information transmission among the stock markets of Greater China, showing that information transmissions have recently been strengthened and that China's stock markets are well connected with their neighbor markets, Taiwan and Hong Kong.

In this context, we adopt multivariate BEKK (Baba, Engle, Kraft, and Kroner)-GARCH (Generalized Auto Regressive Conditional Heteroskedasticity) models to investigate the information transmission mechanism among the Mainland China [Shanghai Stock Exchange Composite Index (SSEC)], Hong Kong [Hang Seng Index (HSI)], and Taiwan [TSEC (Taiwan Stock Exchange Corporation) Weighted Index (TWII)] stock markets. Using VAR(1)-BEKK(1, 1) and VECM(1)-BEKK(1, 1) models, we endeavor to identify the volatility spillover effect, and examine the trilateral relationship among these markets. Previous studies tend to apply bivariate models, which only can explore bilateral relationships. Using these trivariate models, we can analyze how these stock markets simultaneously interact with one another and capture the cross-market influences concurrently. Moreover, our analysis allows for a notable asymmetry feature. Specifically, we classify unexpected events into positive and negative ones, so as to examine whether market volatility increases with bad news. We also plot conditional variances to observe how market volatilities grow and decline through the sample period that coincides with several financial crises. Finally, we utilize the BEKK-GARCH model to generate conditional correlation coefficients so as to capture the dynamic volatility linkages.

We find that the function of return transmission seems to be insignificant among these markets. Only the lagged returns on HSI can predict market returns on TWII. This link between HSI and TWII is also supported by the Granger causality test. By contrast, parts of the empirical results indicate that SSEC can significantly influence HSI and TWII through the volatility spillover effects. These spillover effects are unidirectional, implying that Mainland China might play a role of international center just like the US. However, these cross-market influences are relatively small in comparison with the domestic influences from the home markets. Therefore, our finding also supports the home bias hypothesis.

The rest of this paper is organized as follows. The next section provides some backgrounds and literature review. Section 3 presents the econometric methodology, focusing on the symmetric and asymmetric BEKK-GARCH models. Section 4 provides descriptive statistics of the sample data. Section 5 presents the empirical results, which will be discussed in Section 6. Section 7 concludes.

## 2. Backgrounds and literature review

As mentioned above, return transmission and volatility spillovers are two main channels of the information transmission mechanism, both of which are essential characteristics of financial assets. On the one hand, the efficient market hypothesis ([Malkiel & Fama, 1970](#)) suggests that asset prices have revealed all available information in an efficient market. Accordingly, changes in asset prices indicate incorporation of new information. Since assets are so intertwined, assets can affect one another through price

changes. The influence may even pass beyond borders in an integrated market system. On the other hand, asset prices might exhibit volatility, especially when information comes unexpectedly in clusters. [Kyle \(1985\)](#) argued that information would be revealed in the volatility of stock prices rather than the price itself. Using the no-arbitrage martingale approach, [Ross \(1989\)](#) also confirmed a positive relation of volatility to the rate of information flow. The phenomenon of volatility spillover is a type of comovement among asset prices, suggesting that the volatility of one market might influence the volatility of another market.

Volatility spillover has been extensively studied because of its important role in managing risk and assessing market stability. Many studies found evidence of volatility spillovers across international markets. For example, [Kim, In, and Viney \(2001\)](#) identified the volatility spillover effect in the Australian stock, bond, and money markets. [Yoon and Kang \(2004\)](#) reported a unidirectional volatility spillover effect from the stock market to the bond market of Korea, while [Kim, Moshirian, and Wu \(2006\)](#) found unidirectional volatility spillovers from the bond market to stock market in European countries. Therefore, studies on volatility spillover can help us to understand how information is transmitted across assets and markets. There were also studies on volatility spillovers between spot and futures markets, stock indices ([Booth & So, 2003](#); [Chan, Chan, & Karolyi, 1991](#)), interest rates ([Crain & Lee, 1995](#)), refined petroleum ([Ng & Pirrong, 1996](#)), wheat ([Crain & Lee, 1996](#)), and foreign exchange ([Wang & Wang, 2001](#)). Following these pioneering studies, mechanisms of information transmission among financial markets have become the focus of recent studies.

In addition, volatility has been believed to be larger in a bear market than in a bull market ([Cappiello, Engle, & Sheppard, 2006](#); [French, Schwert, & Stambaugh, 1987](#); [Nelson, 1991](#); [Schwert, 1989](#)). [Black \(1976\)](#) and [Christie \(1982\)](#) explain the phenomenon with the leverage effect, suggesting that upsurge in financial leverage due to falling stock prices might increase volatility. Alternative explanations include a positive feedback effect of volatility ([Bekaert & Wu, 2000](#); [Campbell & Hentschel, 1992](#)), short selling restrictions ([Jayasuriya, Shambora, & Rossiter, 2009](#)), behavioral preferences ([Hens & Steude, 2006](#)), and expected risk premium ([Cho & Engle, 1999](#)). For an overview see [Talpepp and Rieger \(2010\)](#).

## 3. Methodology

In the context, two multivariate GARCH models, VAR(1)-BEKK(1,1) and VECM(1)-BEKK(1, 1), are employed to examine the trilateral relationship among the Mainland China (SSEC), Hong Kong (HSI), and Taiwan stock markets (TWII). Prior studies tend to investigate the first-moment return relationship among international markets, but ignore the second-moment effects—volatility. Since information affects both the first- and the second-moment returns, models without taking volatility into account may be misspecified, and produce incorrect inferences ([Chan et al., 1991](#); [Wong et al., 2007](#)). As result, the multivariate GARCH models, which consider both mean returns and return volatility, provide an appropriate approach to exploring the information transmission mechanism. The present study focus on two channels of information transmission: return transmission and volatility spillovers. Specifically, the mean equations of these models are designed to explore return transmission, while their variance equations, set in the form of BEKK(1,1) GARCH, aim to investigate the volatility spillovers among these markets.

### 3.1. Return transmission

When examining the return transmission among these stock markets, each return series is modeled as a function of its own

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