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Return and volatility spillovers among the East Asian equity markets

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ABSTRACT

This article examines the extent of contagion and interdependence across the East Asian equity markets since early 1990s and compares the ongoing crisis with earlier episodes. Using the forecast error variance decomposition from a vector autoregression, we derive return and volatility spillover indices over the rolling sub-sample windows. We show that there is substantial difference between the behavior of the East Asian return and volatility spillover indices over time. While the return spillover index reveals increased integration among the East Asian equity markets, the volatility spillover index experiences significant bursts during major market crises, including the East Asian crisis. The fact that both return and volatility spillover indices reached their respective peaks during the current global financial crisis attests to the severity of the current episode.

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1. Introduction

The financial crisis that started in the US sub-prime mortgage market in February 2007 reached its climax in mid-September 2008 with the disastrous collapse of the Lehman Brothers. As the global financial crisis have unfolded in several stages, financial markets all around the world went through wild fluctuations, with volatility spreading across markets at an unprecedented speed.

The current financial crisis is not the first of its kind. Following the globalization wave of the early 1990s, financial market crises have become a more frequently observed phenomena, especially in the emerging market economies. During these crises, volatility in financial markets has increased sharply as the stock returns moved into negative territory. As the initial tremors of each of these crises are not confined to the originator country but spread to other countries as well, it is important to obtain a measure of return and volatility spillovers across countries during financial crises.

Early work on contagion dated back to the aftermath of the October 1987 U.S. stock market crash. However, it was not until after the East Asian and Russian crises of 1997–1998 that financial contagion and spillovers had become a major area of research.[1] From the beginning on, the empirical literature on contagion focused on stock returns, and the possibility of volatility contagion has mostly been ignored in the literature. Departing from the rest of the empirical literature, Edwards (1998), Edwards and Susmel (2001) and Baur (2003) are the only papers on the possibility of contagion taking place through spillovers of volatility across stock markets.

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[1] See Claessens and Forbes (2001) for a collection of major contributions on financial contagion after the East Asian crisis.

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Recently, there have been scores of new research papers mostly focusing on how the current financial crisis has spread around the globe.[2] Among these Diebold and Yilmaz (2009a) proposed a new approach to the analysis of contagion and interdependence across markets. In this paper, we follow in their footsteps. Using separate vector autoregression of returns and range-based volatility estimates for 10 East Asian stock markets, we analyze the differences in the dynamics that drive return and volatility spillovers over time. Variance decomposition analysis of the VAR model allows us to identify spillovers of return and volatility shocks from the indigenous shocks. In order to measure volatility we use efficient range-based volatility estimate that was first proposed by Garman and Klass (1980).

In this paper, we focus on major East Asian stock markets only. Over the last two decades, East Asian economies and markets have developed into a powerhouse in the global economy. In addition to attaining a growth rate well above the world average, with their rapidly developing financial markets, the East Asian economies started to play an increasingly influential role in the global financial system. As a consequence, it is interesting to study how the region's markets are affected during different financial crisis episodes since early 1990s and especially during the current global financial crisis.

We apply VAR model and the variance decomposition analysis to 100-week long rolling windows of East Asian stock returns and volatility measures separately. For each window we calculate the contribution of spillovers across markets to the variance of forecast errors. Plotting the total contribution of spillovers in all markets across time we obtain a measure of spillovers across markets. Our approach differs from the main contributions to the literature on financial contagion (such as Forbes & Rigobon, 2002, and papers in Claessens & Forbes, 2001) in several respects. We do not test for contagion before and/or after major crisis episodes, the beginning and ending dates of which are determined exogenously. Instead, using a rolling window framework enables us to account for major changes in the return and volatility spillovers separately by plotting the return and volatility spillover indices.

Our empirical results show that there is substantial difference between the behavior of the East Asian return and volatility spillover indices over time. While the return spillover index reveals increased integration among the East Asian equity markets, the volatility spillover index experiences significant bursts during major market crises, including the East Asian crisis. The fact that during the current global financial crisis the return spillover index experienced its most significant burst since 1990s along with the volatility spillover index and both indices reached their respective peaks attests to the severity of the current financial crisis episode.

Section 2 briefly motivates and describes the spillover index methodology, which is based on variance decompositions of forecast errors obtained from a vector autoregression. In Section 3 we use the spillover index methodology to assess East Asian stock return and volatility spillovers since 1992. In this section, we showed that our results are robust to alternative orderings and also to the inclusion of Chinese, Indian and American equity markets in the analysis. In Section 4 we summarize our results.

2. Measuring return and volatility spillovers

In this section, we describe the spillover index methodology proposed by Diebold and Yilmaz (2009a), which we use to measure return and volatility spillovers in East Asia.[3]

In a nutshell, we model the stock market returns (or volatilities) as an N-variable vector autoregression (VAR). For each stock market i we add the shares of its forecast error variance due to shocks in other stock market j, for all $j \neq i$. Then we sum across all $i = 1, \ldots, N$ to obtain the spillover index. In other words, the spillover index is equal to the sum of all non-diagonal elements in the forecast error variance matrix.

Now let us describe how we obtain the spillover index in some detail. First consider the covariance stationary pth-order N-variable VAR,

$$x_t = \sum_{i=1}^{p} \Phi_i x_{t-i} + \varepsilon_t, \tag{1}$$

where $x_t = (x_{1,t}, \ldots, x_{N,t})'$, Φ is a NxN parameter matrix and the vector of error terms ε has zero mean and the covariance matrix Σ. In our framework, x will be either a vector of stock returns or a vector of stock return volatilities. Assuming that VAR system is covariance stationary, its moving average representation exists and is given by

$$x_t = \sum_{i=0}^{\infty} A_i \varepsilon_{t-i} \tag{2}$$

where the NxN coefficient matrices A_i obey the recursion $A_i = \Phi_1 A_{i-1} + \Phi_2 A_{i-2} + \cdots + \Phi_p A_{i-p}$ with A_0 being an NxN identity matrix and $A_i = 0$ for $i < 0$.

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[2] See for example, Baur and Fry (2009), Dooley and Hutchison (2009), Frank and Hesse (2009), and IMF (2008).

[3] Rather than just limiting the analysis to the measurement of total spillovers, Diebold and Yilmaz (2008) use generalized VAR approach proposed by Pesaran and Shin (1998) to obtain measures of directional spillovers across asset markets over time.

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