Economic Modelling 35 (2013) 338–348

Contents lists available at ScienceDirect

Economic Modelling

journal homepage: www.elsevier.com/locate/ecmod

Determinants of stock market comovements among US and emerging economies during the US financial crisis ☆

Eugene Hwang [a], Hong-Ghi Min [a,*], Bong-Han Kim [b], Hyeongwoo Kim [c]

[a] Department of Management Science, KAIST, 335, Gwahang-Ro, Yusong, Daejeon, 305-701, Republic of Korea
[b] Department of International Economics, Kongju National University, Kongju, Republic of Korea
[c] Department of Economics, Auburn University, Auburn, AL 36849, USA

ARTICLE INFO

Article history:
Accepted 16 July 2013
Available online xxxx

JEL Classification:
F31
G15

Keywords:
Dynamic conditional correlations
Contagion
Herding
US financial crisis
VIX index
CDS spread

ABSTRACT

By analyzing the dynamic conditional correlations (DCC) of the daily stock returns of 10 emerging economies in comparison with those of the US for the period of 2006–2010, we find different patterns of crisis spillover among 10 emerging economies. While a group of countries has three distinctive phases of crisis spillover (contagion, herding, and post-crisis adjustment), other groups show different phases of crisis spillover. It is also shown that increases in CDS spread and TED spread decrease conditional correlations while increases in foreign institutional investment, exchange market volatility, and the VIX index of the S&P 500 increase conditional correlations.

1. Introduction

The collapse of the US sub-prime mortgage market in the summer of 2007 and the ensuing Lehman failure in September of 2008 triggered a financial crisis in the United States that was considered to be the most serious global crisis since the Great Depression (Claessens et al., 2010). Dooley and Hutchison (2009) contend that financial reforms in emerging economies allowed those countries to insulate themselves from the adverse shocks originating from the US until the summer of 2008. However, this relatively tranquil period came to an end with the Lehman failure in September 2008. Following the Lehman failure, equity prices in Taiwan fell 38.5% in three months. During the same period, the Korean won depreciated against the US dollar by 19.2% as global risk aversion spurred demand for a safe asset (paradoxically, US dollars).

Although an understanding of the characteristics of financial market contagion is very important, previous studies were not successful in reaching a consensus even on the existence of contagion during earlier financial crises. Forbes and Rigobon (2002), for example, claim that virtually all previous evidence of contagion (see, among others, King and Wadhwani, 1990; Calvo and Reinhart, 1996) disappears when unconditional cross-market correlation coefficients are corrected for bias. Corsetti et al. (2005), however, point out that Forbes and Rigobon's test is biased towards the null hypothesis of no contagion, and report stronger evidence of contagion with an alternative test.

In this paper, we investigate the transmission mechanisms (different phases of financial crisis) of the recent US financial crisis into emerging economies and try to find determinants of co-movements of stock markets among the US and emerging economies. Specifically, we try to answer the following two questions. First, do countries in emerging economies have the same phases of crisis transmission as the US? Using the Asian financial crisis data, Chiang et al. (2007) report that Asian countries went through the same three distinctive phases of crisis transmission. First, there were sudden significant increases in dynamic correlations among Asian countries, which could be defined as the contagion period. During this period, the benefit of market portfolio diversification diminishes, since holding a portfolio that is subject to diverse country shocks leads to systemic risk. Second, there were herding phases during which dynamic correlations were maintained at high levels. During this period, any public news in any one country is interpreted as information for the entire region. Finally, there were post-crisis periods during which dynamic correlations adjusted to their pre-crisis level. While Chiang et al. (2007) were successful in identifying three different phases of crisis spillover for Asian countries, they use arbitrary breaks of periods in the analysis and report a uniform pattern for the phases of the crisis for all nine Asian countries. However, since each country has a unique financial structure and has different fundamentals, it is realistic to assume that each country would have

☆ The authors are grateful to an anonymous referee for his/her excellent comments on an earlier manuscript but all remaining errors are ours.
* Corresponding author. Tel.: +82 42 305 6305.
E-mail address: hmin@kaist.ac.kr (H.-G. Min).

0264-9993/$ – see front matter © 2013 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.econmod.2013.07.021

different phases of crisis even with the same external shock. For this reason, we test whether different countries had different phases of crisis spillover during the US financial crisis using the Bai–Perron test (2003) of unknown structural breaks and the GARCH with dummy variables.

Our second research question is as follows: What are the determinants of dynamic conditional correlations among the US and ten emerging economies? While some studies report significant comovement between stock market returns and some exogenous variables (Johnson and Soenen, 2002; Norden and Weber, 2009), little is known about the determinants of dynamic correlations among different countries. We employ the DCCX model of Kim et al. (2012) to find the financial fundamentals that determine the dynamic correlations between US stock returns and those of emerging economies. Our paper is organized as follows. Section 2 reviews the literature and Section 3 deals with econometric models. Section 4 provides estimation results and Section 5 concludes the paper.

2. Literature

An early group of studies (King and Wadhwani, 1990; Baig and Goldfajn, 1999) on stock market comovement (contagion) focuses on finding evidence of a significant increase in cross-country unconditional correlations of stock returns with subsample analysis which are known as crisis date. However, Forbes and Rigobon (2002) claim that previous studies show biased results since they fail to account for heteroscedasticity. Bordo and Murshid (2001) and Basu (2002) are in line with Forbes and Rigobon (2002). However, Corsetti et al. (2005) claim that Forbes and Rigobon (2002) are also biased toward the null hypothesis of no contagion and reconfirm the existence of the contagion effect.

To resolve the heteroscedasticity issue in contagion analysis, some studies (Hamao et al., 1990; Kanas, 1998; Ng, 2000; Kim et al., 2011) utilize the MGARCH model and try to show the existence of a variance spillover effect. Hamao et al. (1990) utilize the ARCH models and report a price volatility spillover effect among three major international stock markets. Similarly, Kanas (1998) employs the EGARCH model and shows spillover effects in the European equity markets. Ng (2000), adopting the multivariate GARCH model, shows that Pacific-Basin stock markets were driven by a regional shock from Japan and a global shock from the US. Following Engle (2002), many studies employ the DCC-MGARCH model to show contagion of financial crisis. Yang (2005), Kuper et al. (2007), and Chiang et al. (2007) investigate the Asian financial crisis and find evidence of contagion by using this model. Yang (2005) examines stock returns of Japan and the Asian Four Tigers with DCC estimation and shows the existence of a volatility spillover effect. Kuper et al. (2007) utilize a similar model in Thailand and Indonesia and report the same volatility spillover effect. Chiang et al. (2007) investigate the same time period and report two different phases of crisis spillover — contagion and herding. Another group of studies (Savva et al., 2009: Frank and Hesse, 2009) tries to analyze he spillover effect of the sub-prime mortgage crisis. Savva et al. (2009) investigate the spillover effect from the US to major European stock markets and identify the role of the Euro. Frank and Hess (2009), using a multivariate DCC-GARCH model, report that interlinkages between funding stress and equity markets in advanced economies and emerging market financial indicators display sharp increases during crisis moments.

On the other hand, a group of studies (Baele et al., 2010; Bracker and Koch, 1999; Brunnermeier et al., 2008; Connolly et al., 2007; Johnson and Soenen, 2002; Norden and Weber, 2009) tried to investigate determinants of stock market comovements. First, Bracker and Koch (1999) find that bilateral import dependence and the size deferential across markets are important for stock market integration. Johnson and Soenen (2002) report that increased bilateral exchange rate volatility and the ratio of stock market capitalization relative to the US are important for the stock market integration. Connolly et al. (2007) identify the implied volatility of a stock market. On the other hand, Norden and Weber (2009) report that positive stock returns are associated with negative CDS spread changes and Brunnermeier et al., 2008 provides a useful basis for gauging the severity of a liquidity crisis. While this group of studies employed the Geweke (1982) measure as a proxy of stock market integration, little is known about the determinants of dynamic conditional correlations among different stock markets.

In our analysis of the DCCX-MGARCH model, we simultaneously estimate dynamic conditional correlations and the impact of exogenous variables on DCCs, which can be used to identify channels of contagion.

3. The dynamic conditional correlation model

3.1. The DCC-GARCH model

We use the dynamic conditional correlation (DCC) estimator proposed by Engle (2002). The DCC model is a flexible yet parsimonious parametric model that has been widely employed.

Let $y_t = [\Delta s_{1,t} \Delta s_{2,t}]'$ be a 2×1 vector of the log of stock market index ($s_{i,t}$) in a conditional mean equation. A VAR representation of the conditional mean equation can be written as in Eq. (1):

$$A(L)\ y_t = e_t, \quad \text{where } e_t \sim N(0, H_t)\ \forall\ t = 1, \ldots..T \tag{1}$$

where $A(L)$is a polynomial matrix in the lag operator L and $e_t = [\varepsilon_{1t}, \varepsilon_{2t}]'$ is a vector of innovations with a conditional variance–covariance matrix $H_t\{h_i\}_t\ \forall i = 1$ and 2. The GARCH component of the framework can be rewritten as $H_i = D_t R_t D_t$, where $D_t = diag\left(\sqrt{h_{i,i,t}}\right)$ and $R_t = \{\rho_{ij}\}_t$ is the time-varying correlation matrix containing conditional correlation coefficients. The elements in D_t follow univariate GARCH (P, Q) processes in the following manner:

$$h_{i,t} = \omega_i + \sum_{p=1}^{P_i} \alpha_{ip} \varepsilon_{i,t-p}^2 + \sum_{q=1}^{Q_i} \beta_{iq} h_{i,t-q} \quad \forall i = 1, 2. \tag{2}$$

The second component of the framework consists of a specific DCC(M, N) structure, which can be expressed as:

$$R_t = Q_t^{*-1}\ Q_t\ Q_t^* \tag{3}$$

where $Q_t = \left(1 - \sum_{m=1}^{M} \alpha_m - \sum_{n=1}^{N} \beta_n\right) \overline{Q} + \sum_{m=1}^{M} \alpha_m (\varepsilon_{t-m} \varepsilon'_{t-m}) + \sum_{n=1}^{N} \beta_n$ Q_{t-n}, $\overline{Q}$ is the unconditional correlation matrix of $\varepsilon_{i,t}$ and $\varepsilon_{j,t}$, $Q_t^* = diag\left\{\sqrt{q_{i,i}}\right\}$ is a 2×2 diagonal matrix containing the square root of diagonal elements in Q_t, and α and β are nonnegative scalars that satisfy $\alpha + \beta \prec 1$.

In this paper, our key element of interest in R_t is $\rho_{1,2,t} = q_{1,2,t} / \sqrt{q_{1,1,t} q_{2,2,t}}^{1,1,t}$, which represents the conditional correlation between US stock returns and those of other OECD countries. The log-likelihood function for this model can be expressed as follows:

$$L = \left[-1/2 \sum_{t=1}^{T} \left(n \log(2\pi) + \log|D_t|^2 + \varepsilon_t' D_t^{-2} \varepsilon_t\right)\right] + \left[-1/2 \sum_{t=1}^{T} \left(\log|R_t| + \varepsilon_t' R_t^{-1} \varepsilon_t + \varepsilon_t' \varepsilon_t\right)\right] \tag{4}$$

Engle (2002) proposes a two-step approach for estimating the DCC model.