Economic Modelling 49 (2015) 198–211

Contents lists available at ScienceDirect

Economic Modelling

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

New empirical evidence from assessing financial market integration, with application to Saudi Arabia

Jamel Jouini *

College of Business Administration, King Saud University, Saudi Arabia

ARTICLE INFO

Article history:
Accepted 26 April 2015
Available online xxxx

Keywords:
Financial integration
Time-varying correlation
Spillover index
Data frequency
Saudi Arabia

ABSTRACT

We examine whether data frequency, day of the week and econometric methodology matter in analyzing financial market integration. As case study, we investigate equity market comovements between Saudi Arabia and a set of international economies. Our findings take the literature forward and indicate that cross-market linkages are weak and subsample-dependent regardless of whether data are daily, weekly (whatever the weekday) or monthly and whatever the econometric approach. The results are relevant for investors who want to be more informed of promising investment opportunities, and for financial makers to take necessary policies to hedge against the effects of shocks.

1. Introduction

The motivating reason behind the financial market integration is the opening policies adopted by emerging countries since the late 1980s, which have provoked great interest in this line of research in recent years. Before we proceed to discuss the novelty of our proposed ideas in this paper, we briefly review the most recent empirical works on cross-market linkages. Qiao et al. (2011) reveal higher correlations among the US, Australia and New Zealand, and stronger and more persistent responses of each market to shocks in the other markets in a bear regime rather than in a bull regime. Syllignakis and Kouretas (2011) provide evidence of increased correlations between the US and Germany and the Central and Eastern European stock markets during the 2007–2009 financial crisis. Lean and Teng (2013) indicate that Malaysia and China become more integrated from April 2004 since the acceleration of trade transactions between them. In addition, the Indian and Malaysian equity markets are strongly integrated. Gjika and Horváth (2013) find that the Central European stock markets are strongly correlated between them and with the euro area particularly after their European Union entry and during the financial crisis. Jouini et al. (2014) reveal that financial integration is generally stronger between emerging countries of the same geographical region. Yamamoto (2014) points that Asian economies, especially the highly developed, are financially linked with the US. A common feature of these studies is that cross-market correlations are time-varying and depend on the market situation (bull or bear).

There are, essentially, key limitations of this literature. In this regard, to the best of our knowledge, three issues have not been previously undertaken and deserve to be well studied. The first issue consists in bringing a more engaging discussion on the importance of data frequency in analyzing equity market integration.[1] The second issue particularly focuses on the dependence of results on the day of the week. The last issue is devoted to the sensitivity of results to different econometric methodologies. In other words, is financial integration among economies robust? These are relevant issues since the related literature mainly uses one data frequency and one econometric approach, and does not address the dependence of financial integration results on the different weekdays although it was shown that stock market returns are day-of-the-week dependent (see inter alia, Cross, 1973; French, 1980; Lakonishok and Levi, 1982). These research gaps outlined in the literature motivate us to revisit the financial market integration despite the abundance of related works. The issues are very pertinent for investors to assess potential gains from international portfolio diversification, and for financial makers to precisely manage market policies and handle contagion risks that might be caused by international shock transmissions.

* Department of Economics, College of Business Administration, King Saud University, P.O. Box 71115 Riyadh 11587, Saudi Arabia. Tel.: +966 11 46 74 151; fax: +966 11 46 73 763.
E-mail address: jjouini@ksu.edu.sa.

[1] In the same context of financial assets, the only work that has examined the effect of data frequency on cross-market linkages is Zhang and Shinki (2007) who study the comovements among spot exchange rate returns. They find that the effects of high data frequency are more important than the effects of low data frequency. The implication is that data frequency matters in analyzing linkages among financial assets. In another strand of the literature, many empirical works have argued the importance of data frequency on hypothesis tests. For instance, we are referred to Narayan and Sharma (2015) for the relationship between forward premium and exchange rate, Phan et al. (2015) for the linkages between stock returns of oil producers and consumers and oil price changes, Narayan et al. (2014a) for commodity futures markets, Narayan et al. (2013) for commodity return predictability, and Maheu and McCurdy (2011) for return forecasts.

http://dx.doi.org/10.1016/j.econmod.2015.04.010
0264-9993/

The paper offers a more comprehensive analysis of cross-market linkages and contributes to the relevant literature in different aspects. First, little attention has been paid to international financial integration of Gulf countries although their increasing economic development (see Abraham et al., 2001; Arouri and Nguyen, 2010; Cheng et al, 2010). For this purpose, we examine cross-market comovements between Saudi Arabia[2] and a set of international economies using the Asymmetric Generalized Dynamic Conditional Correlation GARCH (AGDCC–GARCH) process developed by Cappiello et al. (2006).[3] Considering many countries allows investors to find promising investment opportunities in markets with different levels of financial development. Second, we check whether stock portfolio diversification earnings encompass changes by detecting breaks in cross correlations. This issue, generally ignored in previous works, is pivotal for global investors to undertake profitable investments, and for authorities to conduct appropriate equity market policies. Third, we examine the implications of the 2007–2009 global financial turmoil on cross-market correlations, with a view of bringing out the herding behavior.[4] Fourth, we highlight whether volatilities are relevant drivers of correlations. The final issue is whether results are data frequency-dependent and contingent upon only one econometric procedure? Are they dependent on the day of the week? To answer these questions, we replicate the analysis with daily, weekly and monthly data and for each of the five days of the week. Moreover, we undertake the newly developed Diebold–Yilmaz's VAR-based spillover test as alternative econometric methodology.[5] Thus, in this paper in handling financial integration among economies, we implement a more diversified analysis so that robust results and crucial implications may be reflected in the international equity portfolio diversification process. By doing so, we proceed differently from the extant literature and provide a fresh addition to a lot of empirical work on financial market integration.

Our results provide interesting insights and take the literature forward. First, the financial market integration of Saudi Arabia into international economies is weak and influenced by structural changes in the cross correlations. Investors could then benefit from diversifying equity portfolios in international markets.[6] Second, the findings are robust to the use of different data frequencies and alternative econometric approaches, and are day-of-the-week independent. Therefore, data frequency, day of the week and econometric methodology do not matter in examining equity market comovements. Finally, the results have important implications for investors who want to diversify stock portfolios in heterogeneous markets, and for financial makers to establish necessary market policies to hedge against the effects of shocks.

The remainder of the paper is organized as follows. Section 2 presents the econometric methodology. Section 3 describes the data by motivating the choice of countries and discusses the findings. Section 4 investigates the sensitivity of the results to data frequency and day of the week. In Section 5, we test the robustness of the results to the use of an alternative econometric procedure. Section 6 provides concluding remarks.

2. Econometric approach

We employ the AGDCC–GARCH process developed by Cappiello et al. (2006) that allows computing the time-varying conditional correlations to assess the financial market integration.[7] The model generalizes and improves substantially the DCC–GARCH process of Engle (2002) by accounting for the asymmetry in conditional correlations.[8] The analysis of financial comovements between markets is based on the following model:

$$\begin{cases} r_t = \mu + \Phi r_{t-1} + u_t \\ u_t | \Im_{t-1} \sim N(0,\ H_t) \\ H_t = D_t R_t D_t \end{cases} \tag{1}$$

where $r_t = (r_{1t}, r_{2t}, \ldots, r_{kt})'$ is the vector of k index return series,[9] $\mu = (\mu_1, \mu_2, \ldots, \mu_k)'$ is a vector of constant terms, $\Phi = diag(\phi_1, \phi_2, \ldots, \phi_k)$ is a diagonal matrix of the autoregressive structure, $u_t = (u_{1t}, u_{2t}, \ldots, u_{kt})'$ is a vector of disturbances, $\Im_{t-1}$ is an information set at time $t-1$, H_t is the conditional variance–covariance matrix, $R_t = (\rho_{ij,t}) = Q_t^{*-1} Q_t Q_t^{*-1}$ is the correlation matrix, and $D_t = diag(h_{1t}^{1/2}, h_{2t}^{1/2}, \ldots, h_{kt}^{1/2})$ is a diagonal matrix of conditional standard deviations. In this paper, we allow for asymmetry in volatility and, so, consider the conditional standard deviations obtained from the estimation of the univariate asymmetric GARCH(1, 1) model developed by Glosten et al. (1993), GJR–GARCH(1, 1), and expressed as follows:

$$\begin{cases} h_{it} = c_i + \alpha_i v_{i,t-1}^2 + \beta_i h_{i,t-1} + \gamma_i I\left[v_{i,t-1}<0\right] v_{i,t-1}^2 \\ v_t = D_t^{-1} u_t \end{cases} \tag{2}$$

where the indicator variable $I[\cdot]$ takes 1 if the argument is true and 0 otherwise.[10]

In the DCC–GARCH specification, Engle (2002) defines the matrix Q_t as follows:

$$Q_t = (1-a-b)\overline{Q} + a v_{t-1} v_{t-1}' + b Q_{t-1} \tag{3}$$

where $\overline{Q} = E\left[v_t v_t'\right]$, and a and b are scalars satisfying $a + b < 1$. Under these conditions, $Q_t^* = diag\left(\sqrt{q_{11,t}}, \sqrt{q_{22,t}}, \ldots, \sqrt{q_{kk,t}}\right)$ with $q_{ii,t}$ the ith diagonal element of the matrix Q_t. The correlation coefficients between two equity markets i and j are given by $\rho_{ij,t} = q_{ij,t} / \left(\sqrt{q_{ii,t}} \sqrt{q_{jj,t}}\right)$. The matrix Q_t^* guarantees that R_t is a correlation matrix as long as Q_t is positive definite.

The Engle (2002)'s specification does not account for asset specific news and asymmetry in conditional correlations. Therefore, Cappiello et al. (2006) propose the following modified matrix (see also Sheppard, 2002):

$$Q_t = \left(\overline{Q} - A'\overline{Q}A - B'\overline{Q}B - G'\overline{N}G\right) + A' v_{t-1} v_{t-1}' A + B' Q_{t-1} B + G' n_{t-1} n_{t-1}' G \tag{4}$$

where A, B and G are diagonal coefficient matrices of order k with elements a_{ii}, b_{ii} and g_{ii} respectively, $n_t = I[v_t < 0] \circ v_t$ with $I[\cdot]$ a $(k \times 1)$

[2] The choice of Saudi Arabia is motivated by the fact that Gulf markets were opened gradually to foreign investors because of the financial liberalization and structural reforms undertaken in the mid-2000s. Other salient features are that the Saudi equity market is the greatest Arab market in terms of market capitalization, and Saudi Arabia is a major global oil-exporter and plays a pivotal role in the world oil market. All these factors may expose the Saudi stock market to shocks emanating from the international financial system, and appeal to us to examine the financial comovements between Saudi Arabia and international economies.

[3] By doing this, our empirical study differs from the few works on the Gulf region from the perspective of the econometric methodology.

[4] To the best of our knowledge, our paper is the first to investigate equity market comovements for a Gulf country relative to international economies based on data covering the most recent stock market crash.

[5] It is worth noting that the Diebold–Yilmaz's approach is not much used in the financial economics literature to investigate the interactions among variables. Within this context, we can cite Narayan et al. (2014b) for the dynamic linkages between stock returns and mutual fund flows in India, Zhou et al. (2012) for the spillovers between the Chinese and international stock markets, and Yilmaz (2010) for the interdependence across East Asian equity markets.

[6] Lessard (1973) and Solnik (1974) point that low cross-market correlation is the engine of global portfolio diversification strategy.

[7] Yu et al. (2010) point that equity markets are more integrated if cross correlations increase over time.

[8] Unlike volatility, the asymmetry in conditional correlation has not been considered extensively in the related literature, but it began to intensify with the global financial crisis that has led to turbulent fluctuations in financial markets.

[9] The return series are obtained by taking the first difference of the natural logarithm of two successive index prices.

[10] There is evidence of asymmetry in conditional volatility if the coefficient γ is statistically significant.