Co-movements of GCC emerging stock markets: New evidence from wavelet coherence analysis

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ABSTRACT

This paper examines the short term and long term dependencies between stock market returns for the Gulf Cooperation Council (GCC) Countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates) during the period 2005–2010. Our empirical investigation is based on the wavelet squared coherence which allows us to assess the co-movement in both time-frequency spaces. Our results reveal frequent changes in the pattern of the co-movements especially after 2007 for all the selected GCC markets at relatively higher frequencies. We further note an increasing strength of dependence among the GCC stock markets during the last financial crisis signifying enhanced portfolio benefits for investors in the short term relative to the long term. On the financial side, we uncover that the strength of co-movement between GCC markets may impact the multi-country portfolio's value at risk (VaR) levels. These findings provide potential implications for portfolio managers operating in the GCC region who are invited to consider co-movement through both frequencies and time when designing their portfolios.

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1. Introduction

The behavior of stock market co-movement is a crucial issue in finance as it has important practical implications for portfolio's allocation and hedging strategy design. This issue has received much attention from academic researchers and practitioners since the works of Grubel (1968), Levy and Sarnat (1970), and Longin and Solnik (1995, 2001)…, among others. It is well recognized that the main underlying idea of portfolio theory is connected to the advantages derived from sector and geographic diversification. Meanwhile, during the last two decades, international capital flows have been spectacularly increased subsequent to rapid mutations in global financial markets such as technological innovations and financial markets liberalization. All these factors have considerably raised the degree of stock market integration and promoted empirical research focused on international stock market co-movement. On the empirical side, this main research issue has been basically apprehended in the international finance literature and various empirical methodologies including cointegration approach (Arouri et al., 2011), error correction models, univariate and multivariate ARCH/GARCH-type models (Lin et al., 1994; Theodossiou and Lee, 1993; Chiang et al., 2007; Ho and Tsui, 2003; Conrad et al., 2010; Aloui et al., 2011; Sedik and Williams, 2011) rolling bi-correlation tests (Lim et al., 2008), and copula theory (Ye et al., 2012; Rodriguez, 2007; Aloui et al., 2011; Samarakoon, 2011), were implemented to shed light on stock market co-movement and risk assessment. Overall, they concluded that stock market co-movement is not constant over time. Moreover, some scholars provided strong evidence of increasing international co-movement of stock returns (Brooks and Del Negro, 2006; Forbes and Rigobon, 2002; Karolyi and Stulz, 1996; Lee, 2004; Longin and Solnik, 1995, 2001). However, the distinction between short and long-term investor behavior should be considered in a co-movement analysis. Indeed, from a portfolio's diversification view, portfolio's managers are more interested in stock price co-movement at higher frequencies, that is, short-run movements. By contrast, other investors are concerned with lower frequencies (i.e. long-rum co-movement). Therefore, it would be very useful for portfolio's managers to resort to frequency domain in order to provide better understanding of stock market co-movement behavior at the frequency level.

On the other hand, stock market co-movement has been intensively studied by means of various empirical methodologies but less much attention has been paid to the co-movement analysis in the frequency domain. In this vein, major previous works were devoted to developed stock markets (Madaleno and Pinho, 2010; Rua and Nunes, 2009; Sharkasi et al., 2005; Vacha and Barunik, 2012; Garham and Kiviaho, 2012, 2011).

Despite its recognized utility, analysis in the frequency domain is much less found in the financial and economic empirical literature.

The first implementations of the wavelet approach are in economic in order to explain some linkages between several macroeconomic variables (Ramsey and Zhang, 1996, 1997). Also, Ramsey and Lampart (1998a) employed the wavelet to analyze the interactive relationship between several macroeconomic variables. Karuppiah and Los (2005) used this empirical approach to investigate the co-movement between some Asian exchange rates during the 1997 Asian crisis. Again, wavelet is employed by Nikkinen et al. (2011) to investigate the cross dynamic of exchange rate expectations.

Concerning wavelet implementations in finance, main recent works applied the wavelet analysis for assessing the volatility transmission between the main developed stock markets. In fact, wavelets are considered as a powerful mathematical tool for signal processing which can provide more insights to co-movement among international stock markets via a decomposition of the time series into their time scale component.

From a financial perspective, it is well documented that stock market co-movement can also lead to market contagion. Following Forbes and Rigobon (2002), financial contagion is defined "as a significant increase in cross-market linkages after a shock to an individual country". More precisely, there's contagion only if markets show significant increase in co-movement during crisis period compared with periods of stability. If cross-market co-movement does not increase significantly after the shock, then any continued level of market correlation can be viewed only as interdependence between the two economies.

In this study, we are concerned with GCC stock market co-movement. Our main research objective is to contribute to the literature of stock market co-movement using the Morlet wavelet coherence approach which allows us to analyze the frequency components of the stock market time series without losing the time information. Put it another way, the use of the wavelet approach allows us to detect stock market inter-actions which are hard to test out using any other modern econometric time-series models. The wavelet tools aim at studying the chronological specifications for financial and economic variables. Particularly, the decomposition into sub-time series and the localization of the interdependence between time series are the two most widely considered area of the wavelet approach in finance. As we know, markets consist of traders operating in different time horizons and therefore these traders can behave differently depending on dissimilar time resolutions (daily, monthly, and weekly). Thus, in terms of portfolio management, by analyzing the multi-scale dynamics of time series, the wavelet analysis appears useful for traders in order to analyze their investment horizons in different frequency bands of scale when they make management portfolio decisions.

Furthermore, we should recognize that very less attention has been paid to emerging stock markets. Moreover, there's no empirical research founded on the wavelet coherence analysis and reserved to the stock market co-movement in the GCC region. Indeed, major previous studies employed standard time series econometric methods which consider the frequency and time components separately. As far as we know, this is the first empirical work implementing the continuous wavelet squared coherence to explore the dynamic linkage among the GCC stock markets in the frequency domain.

The paper is structured as follows. Section 2 exposes the related literature and research motivations. Section 3 describes the wavelet coherence approach. Section 4 provides a detailed description of the data. Section 5 relates the results of the wavelet analysis results while Section 6 provides some managerial implications relative to the risk assessment for a GCC multi-country. The paper is closed with summary and some concluding comments.

2. Related literature and research motivations

In the empirical literature several applications of the wavelet coherence were provided by Lee (2004), Gallegati (2005), Sharkasi et al. (2006), Ranta (2009), Rua and Nunes (2009), Madaleno and

Pinho (2010), and Vacha and Barunik (2012). Using the wavelet squared coherence, Rua and Nunes (2009) assessed the co-movement among the major international stock aggregate indexes including Japan, United States, Germany and United Kingdom during the period 1973–2007. The authors pointed out that the strength of the cross-correlations between stock markets depends on the frequency. Also, they showed that co-movements are stronger in lower frequencies. From a financial view, this finding implies that portfolio diversification profits could be more important in the short-term. The same methodology was implemented to sector indexes. The authors concluded that several sectors such as technology and consumer goods exhibit strong cross-correlations at particular frequencies at time periods (Rua and Nunes, 2009). The same approach is implemented by Ranta (2009) to investigate the contagion among major world stock markets during the last 25 years. The author provided strong evidence of co-movement at different time scales. Accordingly, a short time scale correlation increases during several major crisis while long time scale correlation remains almost at the same level. Ranta's (2009) findings were quite similar to those provided by Sharkasi et al. (2006). The authors proposed a novel approach based on the discrete wavelet transform (DWT) to assess the international stock market co-movement by reconstructing them using wavelet component.[2] The authors concluded that developed markets display different responses to financial crashes from emerging ones. They revealed that that emerging markets may take up to two months to recover while developed markets take less than one month to do so. Additionally, they reported that developed stock market exhibits the same co-movement during the recent financial crisis which can be attributed to a strong cooperative behavior of shareholders regarding their patters to selling and buying shares (Sharkasi et al. 2006).

With regard to emerging stock markets, the most relevant studies were provided by Lee (2004), Gallegati (2005), Madaleno and Pinho (2010), Garham and Nikkinen (2011), Garham and Kiviaho (2012), Kiviaho et al. (2012), and Akoum et al. (2012). Lee (2004) employs the wavelet transform to assess international transmission effects. His empirical approach is implemented to three major developed markets and two MENA stock markets. Lee (2004) showed that movements from the developed markets impacted the MENA stock markets but not vice versa. The same issue has been apprehended by Gallegati (2005). He investigated the integration of emerging stock markets within each other's and with some major developed countries by means of DWT. The author was concerned with five MENA stock markets.[3] The author revealed that MENA stock markets are neither regionally nor internationally integrated. Garham and Kiviaho (2012) are also concerned with the MENA region stock market co-movement and with U.S. stock market for the period 2002–2010. Using the wavelet coherence approach with simulated confidence bounds, the authors pointed out a modest degree of co-movement between the U.S. stock market and MENA markets. Madaleno and Pinho (2010) analyze the stock market interactive relationship using of the wavelet coherence under Morlet's specification.[4] They provided strong evidence supporting the assumption that co-movements are varying over time. Additionally, they reported that the linkage among indices was strong but not homogenous across time scales. Vacha and Barunik (2012) adopted the wavelet power spectra and the wavelet coherence under Morlet's specification to high frequency data financial time series to measure the risk and to investigate their interactive link. The authors documented a strong evidence of dynamic cross-correlations between Central European and Western European stock markets. Also, Garham and Nikkinen (2011) are concerned with emerging and developed

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[2] The empirical investigation covered a large sample of both emerging (13 countries) and developed (14 countries) stock markets for the period 1997–2004.

[3] Egypt, Israel, Turkey, Jordan, and Morocco for the period June 1997–March 2005.

[4] Their attention was narrowed on four major developed and emerging stock markets; namely Japan, United Kingdom, United States and Brazil.