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Inter- and intra-regional analysis on spillover effects across international stock markets

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ABSTRACT

This paper examines the inter- and intra-regional spillover effects across international stock markets in London, Paris, Frankfurt, Toronto, New York, Tokyo, Shanghai, Hong Kong, and Mumbai by using both symmetric and asymmetric causality tests. The obtained results show that the inter-regional spillover effect in daytime returns is stronger and more frequent than the intra-regional one. The asymmetric spillover effect is evident for price shocks originating from Asian markets. In addition, the empirical results show that the Shanghai stock market is the least integrated of all nine markets considered.

1. Introduction

The co-movements of stock prices across international equity markets have attracted great attention of financial researchers, practitioners, and regulators since the 1970s (Lucey et al., 2018). The study of co-movements in international stock markets is at the heart of international finance (Bekaert et al., 2009). Early literature in the 1970s uses mainly low-frequency data and finds little evidence of interdependence across international equity markets (e.g., Solnik, 1974). This finding encourages global investment strategies where diversification benefits can be achieved by expanding the investment opportunity set internationally. However, the study of international market co-movements has come full circle (Gagnon and Karolyi, 2006). Over the last three decades, the literature presents strong evidence for increased co-movements in stock prices across international equity markets.

With the availability of high-frequency data and advances of econometric theory, the existing literature confirms the existence of return and volatility spillover effects across international financial markets, showing that the first and second moments (i.e., returns and volatility) of security prices in one market can exert a statistically significant influence on price movements in others. Engle et al. (1990a,b) first introduced the “meteor shower hypothesis” which asserts the existence of the volatility spillover effect across foreign exchange markets, i.e. a volatile day in Tokyo tends to be followed by a volatile day in London that is subsequently opened. Hamao et al. (1990, 1991), among others, find that this meteor shower effect is also present in the return and volatility transmission mechanism across international equity markets (e.g. see Lin et al., 1994; Koutmos, 1996; Nam et al., 2008; Yarovaya et al., 2016; Wu et al., 2017).

Following the seminar work of Hamao et al. (1990), the international spillover literature uses mainly the autoregressive conditional heteroskedasticity (ARCH) type of models to investigate international stock market co-movements. The ARCH framework has been traditionally employed by empirical financial researchers to examine the volatility of time series and was thought to have little relevance for the description of returns. However, Hamilton (2010) points out that even if the primary research interest is in the mean

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(rather than the variance), it is still important to correctly specify the conditional variance of the model when ARCH effects are present in the data. Furthermore, Hamilton (2010) suggests that the parameter estimates themselves should be corrected for the presence of ARCH effect if the size of the estimated coefficients is the primary research interest.

While considering the influence of ARCH effects, this paper investigates spillover effects among the world's nine major stock markets using both symmetric and asymmetric causality tests. First, under the ARCH framework, a return spillover model is employed to investigate symmetric causal relationships across international stock markets. This study distinguishes spillover effects within regions (i.e., the intra-regional spillover effect) and across regions (i.e., the inter-regional spillover effect). For instance, consider the geographic regions, Asia (Shanghai, Hong Kong, Tokyo, and Mumbai), Europe (Frankfurt, Paris, and London,) and North America (Toronto and New York) and the time sequence in which the markets in the respective region open. The markets in Asia are first to open, followed by European and North American markets. As a consequence, the dynamic spillover effects from Asia to Europe and North America (inter-regional) take place on the same calendar day. The dynamic spillover effects across Asian markets (intra-regional), on the other hand, with a one-day lag. Second, this paper uses the asymmetric causality test of Hatemi-J (2012) to study separate information transmission mechanisms of positive and negative price shocks across international stock markets. Existing literature on international spillover effects normally assumes that the impacts of positive price shocks are the same as that of negative ones. The asymmetry in international spillover effects is still an underexplored area.[1] There are only few studies that have considered an asymmetric structure in the international spillover literature (e.g., Koutmos and Booth, 1995; Kundu and Sarkar, 2016; Yarovaya et al., 2017). However, none of these studies have explicitly studied asymmetric effects of positive and negative price shocks on equity indices within the context of the causality impacts across international stock markets.[2]

Last, this paper analyses the international spillover effects between mature and emerging countries. The previous studies demonstrate that emerging markets have become increasingly integrated with global markets, including equities and commodities (e.g., Gogolin and Kearney, 2016; Wang and Firth, 2004; Yarovaya et al., 2016; Bouri et al., 2017; Chen, 2017; Sheng et al., 2017; Wu et al., 2017; Vigne et al., 2017; Lucey et al., 2018). However, few studies consider the Chinese and Indian markets in international financial integration research, despite the fact that China and India are the only two emerging countries whose stock exchanges are members of "1 trillion club".[3] Given the growing influence of the Chinese and Indian economies, it is interesting to investigate how these markets are correlated to other international stock markets.[4]

The contributions of this paper are three-fold. First, this study conducts a thorough inter- and intra-regional analysis on spillover effects across the world's nine major international equity markets. The countries under investigation are among the world's largest economies and include both developed and emerging markets. Second, this article compares the ordinary least squared (OLS) estimators with the maximum likelihood (ML) estimators from a GARCH-type model and provides empirical evidence in support of Hamilton (2010). The study highlights the importance of considering the ARCH effect in examining the magnitude and significance of spillover coefficients. Third, this research considers the asymmetry in international spillover effects in the sense that positive and negative price shocks can have different information transmission mechanisms. The asymmetric causality test developed by Hatemi-J (2012) is implemented in this study. The test utilises a bootstrap simulation approach to generate critical values that are robust to the existence of ARCH effects.

The remainder of this paper is as follows. Section 2 presents data and preliminary analysis. Section 3 discusses the econometric model and empirical results. Section 4 offers a summary of findings and concluding remarks.

2. Data and preliminary analysis

2.1. Data

The stock markets (i.e. London, Paris, Frankfurt, Toronto, New York, Tokyo, Shanghai, Hong Kong, and Mumbai) included in this study are the world's major stock exchanges. The market indices selected to represent these markets are the FTSE100, CAC 40, DAX 30, S&P/TSX, TOPIX, S&P 500, TOPIX, Shanghai A Share, and NIFTY 500 indices. The daily opening and closing prices of these indices are used over the period from 1 January 2004–31 October 2017. The data is obtained from Datastream.

Table 1 summarises basic statistics of open-to-close (i.e., daytime) returns over the sample period. Daytime returns (denoted by R_t) are calculated as log differences of the closing and opening prices.

As shown in Table 1, the third moment (i.e., kurtosis) and fourth moment (i.e., skewness) measures for all return series indicate that the distributions of returns are skewed and leptokurtic. The Jarque-Bera test shows that the null hypothesis of a normal distribution is rejected for all nine markets. This finding is consistent with existing research that has tested for the normality of daytime stock market returns (e.g., Niarchos et al., 1999; Nam et al., 2008). The Ljung-Box Q-statistics for 16 lags show evidence of linear and

[1] It is noteworthy that the asymmetry in conditional volatility has been well studied in early research (e.g., Glosten et al., 1993). This stream of literature investigates asymmetric effects of positive and negative price shocks on conditional volatility of returns under the asymmetric GARCH-types models. Our paper investigates the asymmetric effect within the context of international return spillovers, which is an area that is underexplored.

[2] Koutmos and Booth (1995) investigate the asymmetric volatility spillovers across international stock markets. Kundu and Sarkar (2016) test asymmetric spillovers of risk in one market to the mean of another market. Yarovaya et al. (2017) employ the asymmetric causality test to analyse asymmetries in return and volatility spillovers across stock index futures.

[3] The statistics is based the annual statistics guide (2016) from the World Federation of Exchanges (WFE).

[4] Chen (2017) suggests that the degree of one country's economy integration into the world economy is positively related to the level of its market comovements with international stock markets.