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Macro-economic determinant and interdependence of the stock markets

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Abstract

This study examines the time-varying long-term stock market interdependence between China and the ten emerging economies using Johansen co-integration and Dynamic Conditional Correlation-Generalized Autoregressive Conditional Heteroskedasticity (DCC GARCH) model. It analyses the dynamic association between the equity markets and the macroeconomic determinants using panel regression analysis. **Findings/originality**: The results indicate that the Chinese stock market are co-integrated with the stock market of the other emerging markets. It confirms that the relationship between China and the other emerging economies has been increasing over time. It concludes that there is a long run interdependence between the Chinese and the other emerging economies. In addition, the results of the panel regression show that macroeconomic determinants have no significant effect on the equity market correlations between China and the ten emerging economies.

Introduction

Over the last few decades, government agencies and the key policymakers of both developing and the developed nations have attempted a few measures to abolish the hindrances among the nations to ensure the free stream of resources. This has significantly contributed to the interdependence of the economies and the effect of this association on their equity markets linkages. However, there are predominantly two distinct features in the realm of stock market interdependence. First, to what extent stock markets move together over the period. Second, what are the possible factors behind such a process? Earlier studies paid attention to the first aspect of the stock market interdependence for example (Masih and Masih, 1999; Yang and Lim, 2004). On the one hand, the more contemporary studies investigated the developed and the developing stock markets of USA, European, ASEAN and Asian markets. On the other hand, most of the previous studies examined the stock market interdependence in terms of correlation. Whereas, it is commonly believed that correlation has several deficiencies including the existence and the instability of lags. Therefore, even if the low correlation exists among the stock markets, this can be deceptive if it is time-varying (Arouri et al., 2012; Graham, Kiviaho and Nikkinen, 2012; Ranta, 2013; Wang et al., 2017; Zhang, Zheng, and Zeng, 2017; Nguyen, Bhatti and Henry, 2017).

Recently, financial researchers have mainly devoted their attention to the emerging economies stock markets (Fidrmuc and Korhonen, 2010; Stijn *et al.*, 2010; Graham, Kiviaho and Nikkinen, 2012). In view of that fact, emerging markets have distinctive characteristics from the developed markets in terms of economic conditions, political structure, higher volatility, high interdependence, mean returns, currency, and the low correlation with the developed stock markets (Geert and R. Harvey, 1995; Ragunathan, Faff and Brooks, 1999). However, in these studies, interdependence has been measured between emerging and the developed economies stock markets.

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On the one hand, some previous studies found a strong linkage between macroeconomic factors and the equity market, while some other found that these linkages are rather not robust (Kizys & Pierdzioch, 2009; Verma & Ozuna, 2005). On the other hand, Pretorius (2002) investigated what are the factors behind the stock market interdependence of emerging economies. Paramati, Gupta, and Roca (2015); Paramati, Roca, and Gupta (2016) and Paramati et al. (2017) studies the cross-market linkages between Australia and its trading partners and found trade ties result in equity market interdependence.

But to our best knowledge, there is no major contribution regarding stock market interdependence in emerging economies after the Pretorius because financial crises divert the attention of the researchers. So, in this study it is endeavor first, to fill up the gap and identify what macroeconomic factors are behind the stock market interdependence in emerging economies context, as emerging economies grow in number since last twenty years and secondly, there is dearth of empirical investigation on stock market interdependence that takes the viewpoint of emerging economies, the use of emerging economies perspective provides an opportunity to address this particular gap.

This paper is also different from the other papers in the sense that in this paper the major driver of equity market belongs inside the emerging economy which is Chinese stock market rather than any developed world like in other studies for e.g. US equity markets are considered to be the benchmark equity market as the significance of China is the second largest and shares the major world output among the top ten economies. Moreover, presently China share has grown to 15.1%, while the share of Japan and the USA has fallen down to 31.1%% by 2017 (IMF Economic Outlook 2017).

The aim of this paper is threefold. First, it observes the interdependence among the emerging economies stock markets. Second, it measures the time-varying relationship among the stock markets of emerging economies. Third, it detects the possible macroeconomic determinants behind the interdependence among these markets. The subject of stock market interdependence has immense, theoretical, policy and practical significance. The foremost benefit of the interdependent market is that the cost of and access to foreign investment lower and easier, respectively. To achieve the objective of the study first, we employ the Johansen multivariate co-integration test to ascertain long term association (interdependence). Second, to examine the time-varying association we employ DCC GARCH model. Finally, to detect the influence of macroeconomic variables on the security market interdependence this study employs a panel regression model.

Based on the results of the study it is concluded that stock markets in emerging economies are interdependent on the Chinese stock market. In addition to this, the interdependence between China and the other emerging economies has been increasing over time except for Brazil. However, there is no significant impact of the macroeconomic determinants on the time-varying interdependence between the stock markets of emerging economies.

The subject of stock market interdependence has immense, theoretical, policy and practical significance, still, it is among a debatable issue in the finance literature. This growing significance of the policymaker and investors arise largely as a result of the financial theory which explains that segmented markets are less efficient than integrated markets. In the case of interdependent equity markets, investors can reposition their funds with no trouble around the global markets to gain superior anticipated risk-adjusted returns. The foremost benefit of the interdependent market is that the cost of and access to foreign investment lower and easier, respectively. In addition to this, an event takes place in the one market can trigger the event into other markets, especially during the financial crises. Therefore, the investors and the policy makers are fascinated to know the degree of interdependence. This can assist the policymakers to devise satisfactory policies to control the movement of the resources and to bring stability to their financial system.

The rest of the paper is structured as follows. Section 2 explains the major existing theories and review the concept of market interdependence. Section 3 briefly overviews the methodology including the statistical model and the technique used for the analysis, sampling technique and the sample size and data sources. Section 4 describes the results of empirical testing and its analysis. Section 5 concludes the study by highlighting the main results obtained from the study and the possible extension of the study.

Methods

The sample data used in this paper is related to the stock prices of emerging stock markets including China, Pakistan, Indonesia, India, Malaysia, Brazil, Mexico, Philippines, Hungary and South Africa and macro-economic variables of emerging markets including bilateral trade, inflation, interest rate, industrial production and exchange rates from January, 2010 to May, 2017. Statistical data is gathered from the Yahoo Finance, International monetary fund & international financial statistics web sites. Closing values of all indices & macro-economic variables will be employed for data analysis.

To measure the stock market interdependence, the following are the representative index of each country: KSE 100 index (Pakistan), S&P BSE SENSEX (India), SSE Composite (China), JSKE (Indonesia), FTSE Bursa Malaysia KLCI (Malaysia), PSEi (Philippine), BVSP (Brazil), BUX (Hungary), MMX (Mexico), MICEX (Russia) and FTSE/JSE (South Africa).

In this study, we make use of the Johansen and Juselius technique based on VAR (vector autoregression) of examination for the occurrence of multiple co-integrating vectors. In contrast to the predecessor, the JJ technique have many advantages over the famous two-step Engle-Granger residual based technique. The VAR model with an order of p can be written as:

$$Z_t = C + A_1 Z_{t-1} + A_p Z_{t-p} + \mu t \quad (1)$$

where Z_t represents n x 1 vector of factors are integrated at I (1) and μt is zero mean with a white noise vector process.

In addition to this, Johansen co-integration approach comprises of two dissimilar likelihood ratio test- one is the trace (λ_{trace}) and the other is maximum eigenvalue (λ_{max}), to investigate the long-term relationship between the specified set of factors. The equation of these tests is given below.

$$\lambda_{trace}\,(r) = -\,T \sum_{i=r+1}^{g} \ln(1 - \hat{\lambda}_i) \quad (2)$$

$$\lambda_{max}\,(r, r+1) = -\,T \ln(1 - \hat{\lambda}_{r+1}) \quad (3)$$

Whereas T represents the sample size, $\hat{\lambda}_i$ and $\hat{\lambda}_{r=1}$ are the measured values of the properties roots received from the $\prod$ matrix. The Trace test tests the null hypothesis of the r co-integrating vectors versus the alternative hypothesis of n co-integrating vectors. However, the maximum eigenvalue test has a null hypothesis of the r co-integrating vectors versus the alternative hypothesis of r + 1 co-integrating vectors.

Further, to measure the time-varying interdependence we apply DDC GARCH model because researchers recently have started to use MGARCH-DDC model to measure the time-varying relationship particularly great emphasis paid to financial asset for example (Aloui et al., 2013; Cappiello et al., 2006; Lanza, A., Manera & McAleer, 2006).

Results and Discussion

This section presents the outcomes of the empirical examination. First, to ascertain the long run association between the equity market of China and other emerging economies are discussed.

Second, the result of time-varying interdependence is discussed. Finally, the results of a time series regression are presented. In-depth analysis of the results is discussed in the subsequent sections.

We examine the long-term co-movement between China and the other emerging economies by employing the multivariate VAR based co-integration technique developed by (Johansen, 1991, 1995). Results of the multivariate co-integration are discussed below.

Table 1. Multivariate co-integration

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.62	406.469	285.143	0
At most 1 *	0.543	323.234	239.235	0
At most 2 *	0.516	255.852	197.371	0
At most 3 *	0.468	193.523	159.53	0
At most 4 *	0.435	139.285	125.615	0.005
At most 5	0.27	90.238	95.754	0.113
At most 6	0.245	63.132	69.819	0.152
At most 7	0.198	38.96	47.856	0.262
At most 8	0.123	19.959	29.797	0.426
At most 9	0.089	8.638	15.494	0.31
At most 10	0.007	0.609	3.841	0.435
[2]Trace test indicates 5 co-integrating eqn(s) at the 0.05 level				

Unrestricted Co-integration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.62	83.235	70.535	0.002
At most 1 *	0.543	67.382	64.505	0.026
At most 2 *	0.516	62.329	58.434	0.02
At most 3 *	0.468	54.238	52.363	0.032
At most 4 *	0.435	49.047	46.231	0.024
At most 5	0.27	27.106	40.078	0.626
At most 6	0.245	24.171	33.877	0.443
At most 7	0.198	19.001	27.584	0.415
At most 8	0.123	11.321	21.132	0.615
At most 9	0.089	8.029	14.265	0.376
At most 10	0.007	0.609	3.841	0.435
[3] Max-eigenvalue test indicates 5 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

To explore the long-term association between the Chinese stock market (SSE Composite) with other ten stock markets of emerging economies such as Pakistan (KSE), Malaysia (FTSE BMKLCI), Indonesia (JKSE), Philippine (PSEi), Brazil (BVSP), Mexico (MMX), Hungary (BUX), Russia (MICEX), South Africa (FTSE/JSE) and the India (BSENSEX), we run Johansen's multivariate co-integration, the outcomes are presented in Table.1. It is, therefore, on the basis of results we reject the null hypothesis as stated below:

H_o: There is no long-run relationship between emerging and Chinese stock markets.

Now in the next section, we will examine the time-varying behavior of the relationship pointed out by the test of co-integration, as we know that co-integration only indicates the static relationship over the sampling period. It is, therefore, we will use the DDC GARCH model to overcome this limitation of co-integration.

Table 2. Time-varying conditional correlations Between China and each country

Country	Index	Correlation coefficient	P-value
Pakistan	KSE	0.845	0.000
Malaysia	KLCI	0.813	0.000
Philippine	PSEi	0.834	0.000
Indonesia	JKSE	0.834	0.000
India	BSENSEX	0.860	0.000
Hungary	BUX	0.947	0.000
Mexico	MMX	0.915	0.000
Russia	MICEX	0.957	0.000
South Africa	JSE	0.986	0.000
Brazil	BVSP	-0.708	0.000

The conditional correlations between China and the rest of emerging economies in the MSCI index. The calculated correlations in the above table support that China has a higher positive significant correlation with Pakistan, India, China, Indonesia, Malaysia, Philippine, Hungary, Mexico, Russia, and South Africa. However, Brazil is an exception with higher negative significant correlation with China stock market (see. Table 2). On the basis of the empirical analysis of the time-varying behaviour of stock markets, we can reject the below mentioned null hypothesis.

H_o: There is no dynamic relationship between China and the other emerging economies.

To analyse the influence of the macroeconomic determinants on the stock market correlations between China and the emerging economies we apply the panel regression model.

Table 3. Random Effect Model

Dependent Variable: Correlation				
Method: Panel EGLS (Cross-section random effects)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.633	8.5	0.545	0.585
Trade	8.899	5.788	0.015	0.987
Exchange rate	-9.811	9.988	-0.098	0.922
Industrial Production	2.499	1.277	0.196	0.845
Inflation	-2.688	2.699	-0.999	0.318
Interest rate	-0.001	0	-1.753	0.08

The result of the random effect model presents that there is no single macroeconomic determinant among bilateral trade, inflation differential, interest rate differential, industrial production differential, and exchange rate differential, which report the significance. The results show that macroeconomic determinants have no significant effect on the stock market correlations between China and its companion emerging economies. It is, therefore, we cannot reject the null hypothesis as stated below:

Ho: There is no significant impact of macroeconomic determinants on stock market correlations between China and emerging economies**.**

It is therefore, we can conclude macroeconomic determinants have an insignificant impact on the stock market correlations between China and the emerging economies stock markets.

Results of the study suggest that stock markets in emerging economies are interdependent on the Chinese stock market These outcomes are similar to (Kazi, 2008; Masih & Masih, 1999; Paramati et al., 2015). In addition to this, the interdependence between China and the other emerging economies has been increasing over time except for Brazil. However, there is no significant impact of the macroeconomic determinants on the time-varying interdependence between the stock markets of emerging economies. However, the results of this study are dissimilar to those of (Abdul Karim, B., & Shabri Abd. Majid, 2010; Fazio, 2007) who document that macroeconomic linkages among the countries can drive their stock market interdependence.

Moreover, this study is unique in this sense that previous studies considered the stock markets of advanced economies as a benchmark, however, in this study we use the Chinese stock market as a benchmark economy.

Conclusion

In this paper, first, we investigate the interdependence from the perspective of China and its companion emerging economies stock markets including Chinese, Pakistan, Malaysia, Indonesia, Philippine, Brazil, Mexico, Hungary, Russia, South Africa, and India, through the application of multivariate Johansen co-integration technique. Second, we determine the degree of the interdependence between these markets, through the application of DDC GARCH model. Third, we examine what macroeconomic determinants are significant in establishing the interdependence between China and its companion emerging economies, this study has empirically analyzed the dynamic association between the equity markets and the macroeconomic determinants using panel regression analysis.

The results indicate that the Chinese stock market are co-integrated with the stock market of the other emerging markets. Centered on these outcomes, the null hypothesis of no co-integration between these markets can be rejected. These outcomes are consistent with the earlier studies like (Masih and Masih, 1999; Kazi, 2008; Paramati, Gupta and Roca, 2015). In addition to this, the results of DDC GARCH model support that China has a higher positive significant correlation with Pakistan, India, China, Indonesia, Malaysia, Philippine, Hungary, Mexico, Russia, and South Africa. However, Brazil is an exception with higher negative significant correlation with the Chinese stock market. It also confirms that the relationship between China and the other emerging economies has been increasing over time except for Brazil. Finally, the results of the panel regression show that macroeconomic determinants have no significant effect on the equity market correlations between China and its companion emerging economies. It this, therefore, we can conclude that there is long run interdependence between the Chinese and the other emerging economies.

The major limitation of this study is that we select the emerging economies based on two criteria. First, if the index of the country is available in the MSCI index. Second, if the index of

the country is still present but the data of the index or the macroeconomic data is not available or data is compatible with the sampling time frame. In addition to this, we only select the macroeconomic factors limited to trade, inflation rate, interest rate, industrial production and exchange rates. However, instead of these limitations, this study makes a number of contributions to the contemporary literature of financial economics from the policy and practical point of view.

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