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Comovements and Linkages of Emerging Stock Markets: A Case Study from OIC Member Countries

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This paper investigates the comovements and linkages between selected Organization of the Islamic conference (OIC) stock markets. Comovement and linkages are two different phenomenon and need to be differentiated in the analyses. Time series can move together or share same path in the short or long run without linkages. Performing only cointegration analyses can mislead our result. In order to gauge out and clarify the nature or form of the relationship, multivariate cointegration test, vector error correction model and Granger causality test are employed for the daily stock market indices of Indonesia, Malaysia, Pakistan and Turkey for the period spanning from the first day of January 2000 to 24th October, 2008. Empirical findings indicate that; (a) there is evidence for stock market linkages between Indonesia, Malaysia, Pakistan and Turkey in the sample period. (b) Turkish stock market granger cause the other sample countries` stock markets.

Introduction

The Organization of the Islamic Conference (OIC) is the second largest inter-governmental organization after the United Nations which has membership of 57 countries spread over four continents. The Organization is the collective voice of the Muslim world and ensuring to safeguard and protect the interests of the Muslim world in the spirit of promoting international peace and harmony among various people of the world. The Organization was established upon a decision of the

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historical summit which took place in Rabat, Kingdom of Morocco in 25 September 1969.

Removing or relaxing the economic barriers results increase in international trade and foreign direct investment among the member countries. Increased and motivated financial relationships stimulate the political unification and strategic partnerships which refers to power in the international relations. In this study we try to provide an empirical evidence for a possible economic cooperation among OIC countries.

All OIC member countries have different financial hardships and problems as well as different political systems. Those country specific factors are among the major problems that make the economic unionization not viable at any form for the time being. Cultural similarities are not enough to make cooperation and to implement the same economic system in order to achieve developed economic level.

Since the OIC member countries which consist of Turkey, Malaysia, Indonesia and Pakistan have similar political systems with relatively high GDP growth (5.3%, 5.6%, 6.3%, and 6.5% respectively[2]), therefore it is reasonable to expect that these countries' stock markets have some relationship over the last eight years. However, it hoped that this study can be extended to other OIC countries in our future works.

Using the multivariate cointegration test, Vector Error Correction Model (VECM) and Granger Causality test, this paper investigates whether the stock markets of sample OIC member countries has relationship for the period after the Asian financial crises. Jakarta SE Composite Index, (JSX), Kuala Lumpur Composite Index (KLCI), Karachi SE 100 Price Index (KSE), and Istanbul Stock Exchange National 100 index (ISE) are included.

Specifically this paper focuses on whether there are relationships among selected OIC member countries stock markets. Our interest here is to find empirical evidence on the linkages among the equity markets and give recommendation to policy makers on how to move one step ahead

[2] IMF - World Economic Outlook Database, International Financial Statistics Database (2008)

in the process of closer economic cooperation. This paper contributes to the knowledge of financial market linkages among countries in different regions but similar high growth rates, and stock market linkages among OIC member countries.

Literature Review

In the world equity market, empirical evidences show that US plays the leading and dominant role in every region in the world stock market. Studies by Eun and Shim (1989), Arshanapali et al. (1995), Hassan and Naka (1996), Wu and Su (1998), Bessler and Yang (2003), Cumperayot et al. (2006), Ozdemir and Cakan (2007), Abu Hassan and Ergun (2009) find results supporting US leading role in the world market. However study by Ewing et al. (1999) finds no significant role of the US in Indonesia, Canada and Mexico. Within the European region, Friedman and Shachmurove (1997) report that Germany has a dominant role over the other European countries, and Cheung and Lai (1999) find that the degree of integration and linkage between countries depends on the economic development and the introduction of European Monetary System (EMS) has caused stronger integration in the area.

Among the very limited studies on OIC member's stock market relationships and linkages, it can be said that there are only a few results showing stock market integration among OIC countries. Among them, Shabri at al. (2007), Ceylan and Dogan (2004) find some limited relationships among some OIC member countries. They find linkages between Turkey and Egypt, Lebanon and Kuwait, Jordan and Turkey, Lebanon and Pakistan got stronger after the September 11 incident. Shabri at al. (2007) find no linkages among eight stock markets of OIC countries. Four are from Middle East and North Africa (MENA) region; Turkey, Egypt, Oman and Kuwait and the other four are from the Asian region; Malaysia, Indonesia, Bangladesh, Pakistan.

Hassan (2003) finds that OIC member countries do not invest their surplus funds in other member countries. Most of these surplus funds are invested in developed nations partly in pursuit of higher returns, and partly not being able to invest in other OIC countries due to inefficient OIC stock markets and weak regulatory environment. Hassan and Suk-Yu (2007) recommend more openness and integration among OIC

capital markets in order to achieve financial stability and facilitating economic growth.

Raimi and Mobolaji (2008) suggest on implementing appropriate reforms, starting with free trade, then Custom Union, and finally an Islamic Bloc or Economic Union highlighting the advantages of initiating economic integration among Muslim countries across the globe. They also suggested to look at Europe's experience; its successful economic integration and challenges which trailed the process.

Anjum (2008) states that financial globalization is unavoidable and recommend integration among Islamic countries in order to refrain its detrimental impacts such as atheistic, materialistic, undemocratic, non-universal and interest-based world view and characters.

Methodology

The daily stock market indices for Turkey, Malaysia, Indonesia and Pakistan are obtained from Datastream and transformed to natural logarithms prior to analysis. Our sample data spans from January 1, 2000 to October 24, 2008.

We analyze the stock market relationship between four developing OIC countries highlighting the difference between comovement and cointegration. To do so, we performed multivariate cointegration tests, Granger causality based on vector error correction model (VECM), generalized impulse response function analyses and permanent and transitory variance decomposition analyses.

First, stationary tests which include the Augmented Dickey–Fuller (ADF) (Dickey & Fuller, 1981) and Phillips-Perron (PP) (Phillips & Perron, 1988) are applied to determine the order of integration. Second, Johansen multivariate cointegration test (Johansen, 1988, 1995; Johansen & Juselius, 1990) and VECM is applied to our four-variable model to investigate the dynamic linkages and long-run relationships among the selected OIC member countries.

Defining a vector z_t of n potentially endogenous variables, it is possible to specify the following data generating process, and model z_t as an unrestricted vector autoregression (VAR) involving up to k-lags of z:

$$z_t = A_1 z_{t-1} + A_2 z_{t-2} + ...+ A_k z_{t-k} + u_t \quad u_t \sim \text{IN}(0,\Sigma) \tag{1}$$

where z_t is a (4x1) matrix, and each of Ai is a (4x4) matrix of parameters. Eq.1 can be reformulated into a vector error correction (VECM) form:

$$\Delta z_t = \Gamma_1 \Delta z_{t-1} + \Gamma_2 \Delta z_{t-2} + ...+ \Gamma_{k-1} \Delta z_{t-k+1} + \Pi z_{t-k} + u_t \text{ or} \tag{2}$$

$$\Delta z_t = \sum_{i=1}^{k-1} \Gamma_i \Delta z_{t-i} + \Pi z_{t-k} + u_t \tag{3}$$

where Γ_i =-(I-A_1-. . .-Ai) (i =1,. . ., k-1), Γ_i are interim multipliers, and Π =-(I- A_1-. . .-A_k). Testing for cointegration is related to the consideration of the rank of Π, that is finding the number of r linearly independent columns in Π (cointegrating vectors).

If cointegration is confirmed, then the Granger-causality test based on VECM can be applied to examine the temporal causalities and long run adjustments of our variables.

Impulse response function Analysis

An impulse response function is helpful in tracing the time path of the various shocks on the variables contained in the VAR system (Enders, 1995). The impulse response function describes the impact of an exogenous shock in one variable on the other variables in the model. Pesaran and Shin (1998) have developed a method called the generalized impulse response function (GIRF) which does not impose the orthogonality restriction and thus GIRF are not sensitive to the ordering of the variables in the VAR and provide more robust results. Through the dynamic structure of VAR, a shock to a variable directly affects itself, and all of the endogenous variables.

To carry out the impulse response function analysis, the following VAR model

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} \bar{y} \\ \bar{z} \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}^i \begin{bmatrix} e_{1t-i} \\ e_{2t-i} \end{bmatrix} \quad (4)$$

is rewritten as a moving average representation as follows

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} \bar{y} \\ \bar{z} \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} \phi_{11}(i) & \phi_{12}(i) \\ \phi_{21}(i) & \phi_{22}(i) \end{bmatrix}^i \begin{bmatrix} \varepsilon_{yt-i} \\ \varepsilon_{zt-i} \end{bmatrix} \quad (5)$$

or alternatively

$$x_t = \mu + \sum_{i=0}^{\infty} \phi_i \varepsilon_{t-i} \quad (6)$$

where the coefficients of ϕ_i are known as the impulse response functions. For example, $\phi_{11}(0)$ is the instantaneous impact of a one-unit change in ε_{yt} on y_t. The plot of the impulse response functions (plot of coefficients of ϕ_{jk} against i) allows us to observe the behavior of the $\{y_t\}$ and $\{z_t\}$ series in response to the various shocks. In our case, the $\{y_t\}$ and $\{z_t\}$ series will represent stock market index series of sample countries.

Variance Decomposition Analysis (VDC)

We further investigate the dynamic linkages between stock indices using Sims' (1980) approach. According to Sims, tracing out a vector autoregressive (VAR) system's moving average representation is a better way to provide insights on the dynamic interactions among the variables in the system. In specific, the forecast error variance decomposition analysis based on a VAR model enables someone to evaluate the strength of a causal relation. Note that the multivariate VAR system can be expressed as the moving average model of innovations:

$$Z_t = \sum_{p=0}^{\infty} A_p \varepsilon_{t-p} \quad (7)$$

where Z_t is a 4×1 column vector that contains stock indices and ε_t is a 4×1 column vector that contains innovations of $\varepsilon_{e,t}$ and $\varepsilon_{s,t}$. Eq. (3) indicates that Z_t is a linear combination of current and past one-step ahead forecast errors (i.e., innovations, ε_t). Specifically, the k-step ahead forecast error of Z_t at time t−k+1 is given as;

$$\sum_{p=0}^{k-1} A_p \varepsilon_{t-p} \tag{8}$$

That is, the variance of the k-step ahead forecast errors can be decomposed into each innovation. Thus, the VAR analysis enables us to analyze the variance decomposition of the forecast errors, providing insightful information on unexpected variation in one variable following one unit shock from the other variable in the system.

Empirical Result

Unit root test results indicate that all series of sample variables are I(1) (non-stationary in levels but stationary in first differences).

Once all series are found to be I(1), we proceed to employ Johansen multivariate cointegration procedure in order to gauge out presence of cointegration vectors. Results of cointegration test appear in Table 1. There is enough evidence for the existence of significant cointegration relationship between stock market indices of selected OIC countries based on the Johansen cointegration test result.

Table 1 Johansen Cointegration Test result

Models	Lag	Trace	λ_{max}
Indonesia, Malaysia, Pakistan, and Turkey	4	60.527*	32.764*

*Trace and max-eigenvalue test indicates 1 cointegrating equation at the 0.05 level

Granger Causality based on VECM

According to the Granger if there is cointegration between variables, it must be at least one way causality relations. Granger causality result based on VECM is presented in Table 2 and in Figure 1. Short run causal relationships are detected between stock markets of Turkey and Indonesia, Pakistan and Malaysia. For the Indonesia equation, short and long run causality between Turkey and Indonesia stock market indices are detected by both F-statistics for the lagged independent variable and t-statistics of the error correction term. Furthermore, short run causality between Indonesian stock market and Malaysian stock market was found. In conclusion, Turkey stock market has short run unidirectional relationship with Indonesia, Pakistan and Malaysia stock markets.

Table 2. Granger Causality based on VECM

	Independent Variables				
Dependent Variables	Indonesia	Malaysia	Pakistan	Turkey	ECT
		F-statistics			t-statistics
Indonesia		0.4772	1.688	5.765*	-5.759*
Malaysia	7.118*		2.636	6.181*	-1.212
Pakistan	0.653	0.553		7.342*	-1.185
Turkey	4.624	2.038	0.553		-0.928

* denotes statistical significance at 1% level

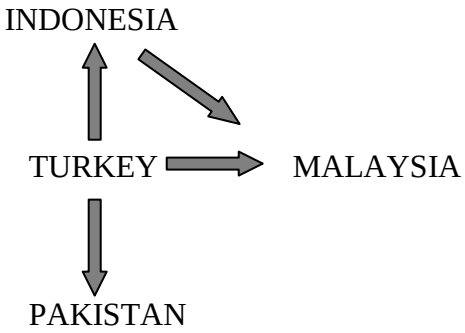

Figure 1 Granger Causality test result

Generalized Impulse Response Function

The impulse response function describes the impact of an exogenous shock in one variable on the other variables of the model. The generalized impulse response function (GIRF) developed by Pesaran and Shin (1998) does not impose the orthogonality restriction which implies that impulse responses are not sensitive to the ordering of the variables in the VAR and provide more robust results. The sign and timing provided by GIRF are interesting because they reveal market linkages in the form of how a shock in one country affects another country: If there is no linkage, there will be flight of capital from one economy to another, resulting in a positive impact on the latter markets. In contrast, if investors view other regional economies as prone to similar events, then there will be a negative reaction in those economies.

GIRF are obtained from VECM model. If the influence of a shock in the variables does not disappear in the long run time period then we say that the effect is permanent. In the transitory effect the system goes back to its previous equilibrium level after given shock. GIRF for each market is indicated in Figure 2 for 30 days horizon. With the exception of Turkish stock market all stock markets respond positively to one standard deviation shock in the other variables. Turkish stock market is the most exogenous market. Reaction of Turkish stock market to other stock markets is close to zero. After given shock, all stock markets return to their own equilibrium level indicating transitory effects in the response.

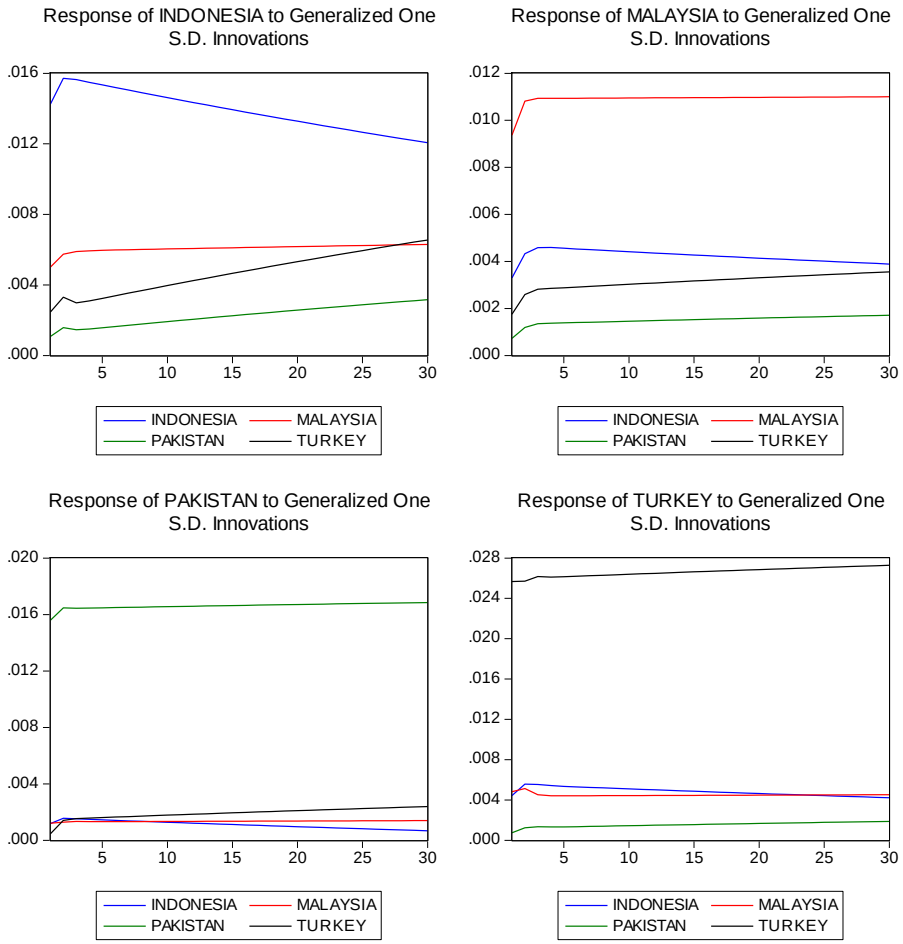

Figure 2 GIRF test Result Graphs

Variance Decomposition (VDC) Analysis

VDC analysis gives information about the relative importance of each random innovation to the variables in the model. Thus, it provides information relative to the size of endogenous and exogenous shocks on a given market. Table 3 presents the variance decomposition of the variables in the model for 30 days horizon. The table shows the percentage of the forecast error variance for each variable that is attributable to its own shocks and to shocks in the other variables in the

system. The analyses result indicates that 95% of Indonesian, 98.3% of Pakistan, 95.2% of Turkey, and 83.9% of Malaysian stock markets' own variances explained by its own shocks. Almost all of the variation in the variables in our model is explained by their own shocks except for Malaysia whereby about 12.3% of its variance is explained by the innovation in Indonesian stock market starting from the first day. Hence, it can be said that Malaysia stock market is relatively endogenous compared to the other three countries.

Table 3 VDC Test Result

	Indonesia	Malaysia	Pakistan	Turkey
A.Indonesia				
1	100	0	0	0
10	99.443	0.185	0.102	0.268
20	97.807	0.509	0.379	1.302
30	95.069	0.974	0.835	3.12
B. Malaysia				
1	12.383	87.616	0	0
10	16.385	82.949	0.197	0.468
20	15.61	83.374	0.28	0.734
30	14.71	83.905	0.362	1.021
C. Pakistan				
1	0.574	0.294	99.13	0
10	0.721	0.284	98.543	0.45
20	0.577	0.333	98.442	0.646
30	0.457	0.384	98.314	0.843
D. Turkey				
1	2.977	1.836	0.007	95.178
10	4.013	1.228	0.086	94.671
20	3.65	1.222	0.121	95.005
30	3.302	1.267	0.157	95.272

Conclusion

This paper empirically examine the comovement and linkages among four emerging Organization for Islamic Conference stock markets which consist of Indonesia, Malaysia, Pakistan and Turkey in a multivariate framework. The current estimation methods used in this study include the multivariate static and dynamic cointegration tests, Granger causality based on VECM, generalized impulse response function analyses, permanent and transitory variance decomposition analyses based on the daily stock data transformed to natural logarithms. The main finding suggests that Indonesia, Malaysia, Pakistan and Turkey stock markets are cointegrated. This result is viable not only to international portfolio investors but also to policy makers who are responsible to develop good and efficient economic relationship among OIC member countries. Moreover, Granger causality is found from Turkey stock market to all the other stock markets. These findings have implications for policy makers suggesting economic cooperation among OIC member countries is applicable. The reported findings also indicate that Turkey stock market is the most exogenous in the model.

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