International Economic Studies
Vol. 42, No. 1, Spring & Summer 2013
pp. 23-30
Received: 12-11-2012, **Accepted:** 10-5-2013

Dynamic Linkages between Exchange Rates and Stock Prices: Evidence from Iran and South Korea

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Abstract
The main purpose of present study is to analyze the relationship between stock and exchange markets in two Asian countries, Iran and South Korea. A monthly time series of stock price and exchange rate are used over the period 2002: 05 - 2012: 03. The data is collected from the Central Bank of each country and WDI. The calculated stock return and real exchange rate change are used in analysis. An econometric multiple generalized autoregressive conditional heteroscedasticity (MGARCH) BEKK method and the Rats software are applied to analyze a dynamic relationship between two markets in each country. The estimated results show a bidirectional relationship between two markets in South Korean economy and only a unidirectional relationship from exchange market to stock market in Iranian economy. The persistence of volatility transmission effects of each market on its own is also found in each economy. In the exchange market, this effect is in opposite direction in Iran compared to Korea, whereas in the stock market both effects are positive and almost the same in two economies. The policy implication of finding is clear. The financial policymakers should watch both stock and exchange markets in two economies to prevent the bidirectional volatility effects between two markets in Korea and the unidirectional volatility from the exchange market to sock market in Iran.

Keywords: Stock price, Exchange Rate, MGARCH-BEKK, Asian Economies.

JEL Classification: F31, G10

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1. Introduction:

A strong linkage between stock prices and exchange rates is a popular view in the financial press. In literature, a number of hypotheses also suggest a causal relation between stock prices and exchange rates.

The linkage between exchange and stock markets is explained through different theoretical models. One theory is based on flow-oriented model which considers the current account of the economy and another theory is identified as the stock-oriented model. According to Granger, Haung, and Yang (2000), these theories are renowned as traditional and portfolio approaches. First theory argues that causality runs from exchange market to stock market. The second theory describes that changes in the stock market affects the exchange market (Ali et al., 2013).

The flow-oriented model of exchange market states that changes in exchange rate affect international competitiveness and trade balances, thereby influencing real income and output. Stock prices, generally interpreted as the present values of future cash flows of firms, react to exchange rate changes and form the link among future income, interest rate innovations, current investment and consumption decisions (Dornbusch and Fischer, 1980). The stock-oriented model of exchange rates, developed by Branson (1983) and Frankel (1983), views exchange rates as equating the supply and demand for assets such as stocks. This approach determines exchange rate dynamics by giving the capital account an important role. Since the values of financial assets are determined by the present values of their future cash flows, expectations of relative currency values play a considerable role in their price movements. Therefore, stock price innovations may affect, or be affected by, exchange rate dynamics (Zhao, 2010).

The goods market hypothesis suggests that changes in exchange rates affect the competitiveness of multinational firms and hence their earnings and stock prices. A depreciation of the local currency makes exporting goods cheaper and may lead to an increase in foreign demand and sales. Consequently, the value of an exporting firm would benefit from a depreciation of its local currency. On the other hand, because of the decrease in foreign demand of an exporting firm's products when the local currency appreciates, the firm's profit will decline and so does its stock price. In contrast, for importing firms the sensitivity of firm value to exchange rate changes is just the opposite. An appreciation (depreciation) of the local currency leads to an increase (decrease) in the firm value of importing firms. Additionally, variations in exchange rates affect a firm's transaction exposure. That is, exchange rate movements affect a firm's future payables (or receivables) denominated in foreign currency. For an exporter, an appreciation of the local currency reduces profits, while a depreciation of the local currency increases profits. Furthermore, stock prices could be affected by exchange rate movements because such movements will induce equity flows.

According to the portfolio balance approach, exchange rates, like all commodities, are determined by market mechanism. A blooming stock market would attract capital flows from foreign investors and hence causes an increase in the demand of a country's currency and vice versa. As a result, rising (declining) stock prices are related to an appreciation (depreciation) in exchange rates. Moreover, foreign investment in a country's equity securities could increase over time due to the benefits of international diversification that foreign investors would gain. In addition to returns, capital flows can be induced by less risky investment climate of a country. An improvement in a country's investment climate (e.g., a stable political system, a fair legal system, financial openness and liberalization, etc.) will lead to capital inflows and a currency appreciation. Furthermore, movements in stock prices may influence exchange rates since investors' wealth and money demand may depend on the performance of the stock market. For example, during the time of a crisis (e.g., the 1997 Asian financial crisis), a sudden dislocation of asset demands may incur because of the herding behavior of investors or the loss of confidence in economic and political stability. This dislocation usually results in the shift of portfolio preference from domestic assets to assets denominated in other currencies, implying a decrease in the demand of money. This will lead to a decrease in the domestic interest rate and in turn lead to capital outflows. Consequently, the currency will depreciate (Pan et al., 2007).

Following the introduction, in section 2 the literature is reviewed, data and methodology is presented in section 3, and the concluding remark is in the last section.

2. Literature Review

Although the theoretical literature suggests causal relations between stock prices and exchange rates, empirical evidence is rather

mixed. Some studies found positive relationship between exchange and stock prices, some found negative relationship, and some others found no interrelationship between two prices.

Franck and Young (1972) was the first study that examined the relationship between stock prices and exchange rates. They use six different exchange rates and found no relationship between these two financial variables. Aggarwal (1981) finds that U.S. stock prices and the trade-weighted dollar are positively correlated. Solnik (1987) studies nine western countries and finds a positive but insignificant relationship between stock and exchange markets. Soenen and Hennigar (1988) find a strong negative correlation between U.S. stock indexes and a fifteen currency-weighted value of the dollar. Chamberlain, Howe, and Popper (1997) show that the U.S. banking stock returns are very sensitive to exchange rate movements. Chiang and Yang (2003) confirm that stock returns and currency values are positively related for nine Asian markets. Wu (2000) verifies that Singapore dollar exchange rates Granger cause stock prices.

On a macro level, Ajayi and Mougoue (1996) confirm significant interactions between daily exchange rates and stock returns. They provide evidence to indicate unidirectional causality from the stock to the currency markets for advanced economies and no consistent causal relations in emerging markets. Abdalla and Murinde (1997) document that a country's monthly exchange rates tend to lead the stock prices, but not the other way around. They find a unilateral causality initiated by exchange rates to stock price in Pakistan, South Korea, and India. Wu (2000) finds that Singapore-dollar exchange rates Granger cause stock prices (Pan et al., 2007).

Bahmani-Oskooee and Sohrabian (1992) show that there is bidirectional causality between stock prices measured by the S&P 500 index and effective exchange rates of the dollar. Similar results are found in respect to long-run by Neih and Lee (2001). Jorion (1990, 1991), Bodnar and Gentry (1993), and Bartov and Bodnar (1994) all fail to find a significant contemporaneous relation between U.S. dollar movements and stock returns for U.S. firms. Donnelly and Sheehy (1996) document a significant contemporaneous relation between exchange rate and the market value of large U.K. exporters. Yu (1997) studies the relationship between exchange and stock markets in three Asian countries, Hong Kong, Japan, and Singapore. He finds a bidirectional causal relationship in Japan but a unidirectional causality from the stock market to exchange market in Hong Kong and no such relation is found for the Singapore market. Granger, Huang and Yang (1998) examine the causality issue using Granger causality tests for nine Asian countries, included Hong Kong, Indonesia, Japan, South Korea, Malaysia, Philippines, Singapore, Thailand and Taiwan. For Japan and Thailand, exchange market leads stock market with positive correlation. For Taiwan, stock market leads exchange market with negative correlation. No relationship was found for Singapore and bidirectional causality was discovered for the remaining countries. Ramasamy and Yeung (2002) examine the links between the foreign exchange and stock markets in six Asian countries and find that there are inconsistent results for bivariate causality between stock prices and exchange rates. Pan, Fok, and Liu (2007) examine dynamic linkages between exchange rates and stock prices for seven East Asian countries, excluding China. Yau and Nieh (2009) investigate the exchange rate effects of the New Taiwan dollar against the Japanese Yen (NTD/JPY) on stock prices in Japan and Taiwan. They find a long-term equilibrium and asymmetric causal relationships (Zhao, 2010).

3. Data and Methodology

The monthly data for two countries, Iran and South Korea, covers the period of 2002: 05-2012: 03. All variables data are collected from the Central Bank of each country and WDI. The base year is 2010: 01. The data includes stock price indices (*P*), nominal exchange rates (NE), domestic and world consumer price indices (*CPI*). The real market exchange rate (R_1) at time *t* is calculated using the following definition:

$$R_{1,t} = (NE_t)(\frac{CPI_{W,t}}{CPI_{D,t}}) \quad (1)$$

In Equation (1), CPI_D and CPI_W are domestic and world consumer price indices, respectively. The *CPI* of the USA (CPI_{USA}) is used as a proxy for the world (CPI_W). The stock market return at time *t* (R_{2t}) is computed based on the natural logarithm (Ln) of the ratio of current stock market price index (P_t) to previous stock market price index (P_{t-1}):

$$R_{2,t} = Ln(\frac{P_t}{P_{t-1}}) \quad (2)$$

Figures 1 to 4 display the patterns of variables over the entire period. Table 1

summarizes the descriptive statistics of the model variables in both countries.

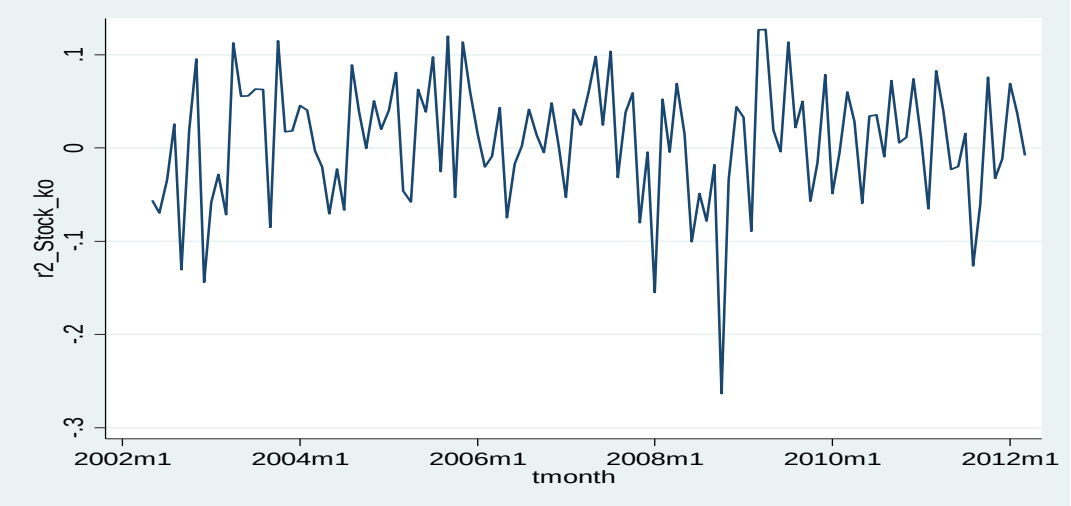

Figure.1: Stock Return in Korea

***Source*:** Authors

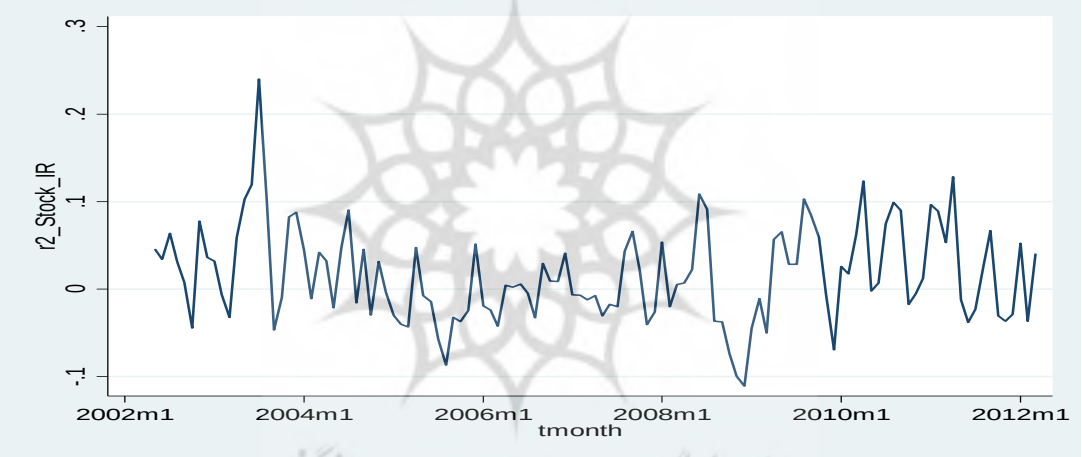

Figure.2: Stock Return in Iran

***Source*:** Authors

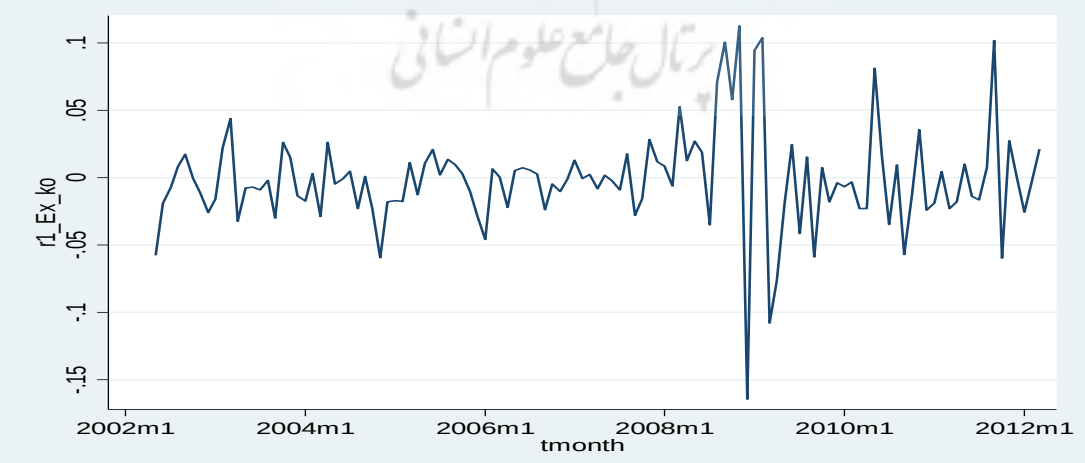

Figure.3: Real Exchange Rate Changes in Korea

***Source*:** Authors

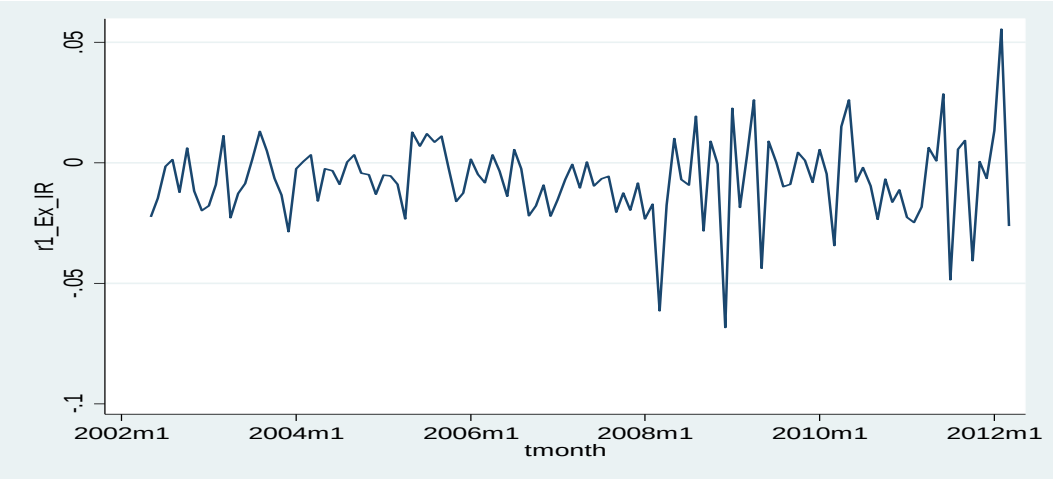

Figure.4: Real Exchange Rate Changes in Iran

***Source*:** Authors

From Table.1, the mean values of stock returns in two markets are both positive, ranging from a minimum -0.11 (Iran) to a maximum 0.13 (Korea). According to the sample standard deviations, Iranian stock return, with a standard deviation of 0.055 compared to Korean stock return of 0.066, is less volatile. Figures 1 & 2 also confirm this by providing a visual perspective on the volatility of stock return series over the period. The mean values for the exchange rate changes in two markets are both negative, ranging from a minimum -0.007 (Iran) to a maximum 0.113 (Korea). According to the sample standard deviations, Iranian real exchange rate change, with the standard deviation of 0.017, compared to 0.037 in Korea, is less volatile. Figures 3 & 4 also confirm this by providing a visual perspective on the volatility of exchange rate change series over the period. With the absolute value of correlation coefficients of approximately 0.405, the Korean stock return and exchange rate change series are highly correlated compared to a low correlation coefficient of 0.091 in Iran.

Table.1: Descriptive Statistics of Variables

	Iranian Exchange rate changes (IR_1)	Korean Exchange rate change (KR_1)	Iranian Stock return changes (IR_2)	Korean stock return changes (KR_2)
Mean	-.0067593	-.0016472	.0157727	.0073257
Median	-0.006680	-0.002277	0.006954	0.014681
Maximum	.0553088	.1125281	.2399785	.126848
Minimum	-.0683142	-.1642634	-.1108718	-.2631117
Std. Dev.	.016634	.0374433	.0547892	.0658782
Skewness	-.3255497	.017109	.6521037	-.7372255
Kurtosis	5.9134	7.115263	4.213184	4.41258
Jarque-Bera	44.18807	83.97641	15.73193	20.67342
p-value	0.000000	0.000000	0.000384	0.000032
Correlation coefficients	---	---	-0.0905	- 0.4050

***Source*:** Authors

The following bivariate GARCH–BEKK(1,1) model is applied to find the interrelationship between two markets:

$$R_t = \alpha + AR_{t-1} + \varepsilon_t = \begin{bmatrix} R_{1,t} \\ R_{2,t} \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{21} \end{bmatrix} \begin{bmatrix} R_1 \\ R_2 \end{bmatrix} \quad (3)$$

where, R_t is a variable normal distributed, $f(R_t|I_{t-1};\theta) = \frac{1}{2\pi}|H_t|^{-1/2}\exp(-\frac{\varepsilon_t^T(H_t^{-1})\varepsilon_t}{2})$, $H_t = [h_{ij,t}]$ is a 2x2 positive definite matrix of $H_t = B^T B + C^T \varepsilon_{t-1}\varepsilon_{t-1}^T C + G^T H_{t-1} G$, $\alpha = \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix}$ is the long term drift coefficients, $A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{21} \end{bmatrix}$ denotes the matrix elements (a_{ij}), which are the means spillovers effects from market *i* to market *j*, ε_t is the error term with $\varepsilon_t = H_t^{\frac{1}{2}} v_t$, $\varepsilon_t | I_{t-1} \sim N(0, H_t), I_{t-1}$ stands for the information set of time t − 1[space], v_t is white noise error terms with the covariance matrix I, *B* is a 2x2 upper triangular

matrix, C = [c_{ij}] is a 2x2 matrix. The element c_{ij} is the impact of market *i* volatility on market *j* and reflects ARCH effect of volatility, G = [g_{ij}]: a 2x2 matrix. The element g_{ij} is the persistence of volatility transmission between market *i* and reflects GARCH effect of volatility.

The basic BEKK was proposed by Engle and Kroner (1995). The BEKK model is in fact a restricted version of the VEC model. The VEC model proposed by Bollerslev, Engle, and Wooldridge (1988) is a straightforward generalization of the univariate GARCH model to the multivariate case. The BEKK model has been designed to ensure the positive definiteness of the variance covariance matrix H_t.

The PP unit root test is applied to make sure of the stationary of variables. Table.2 shows that all variables are stationary. The bivariate GARCH – BEKK(1,1) Equation (3) is estimated applying the maximum likelihood method and BHHH algorithm. (RATS8.2 software is used to estimate the parameters.) Table 3 shows the estimation results. From this table, more than half of the parameters, such as a_1, a_2, a_{22}, b_{11}, c_{11}, c_{12}, c_{21}, g_{11} and g_{22}, are statistically significant in Iranian economy. But in Korean economy, only five parameters, such as c_{11}, c_{12}, c_{21}, g_{11} and g_{22}, are statistically significant. These parameters are defined as follows:

- The a_1 and a_2 parameters indicate the long term drifts in both exchange and stock markets.
- The a_{22} parameter is the mean spillovers effects in stock market on its own.
- The b_{11} parameter is the constant term in matrix *H*.

Table.2: Variables PP Unit Root Tests

Country	Variable	Test statistics	1%	5%	10%	
Iran	R_1	-131.476 -64.264	-27.520	-20.772	-17.560	Z(rho)
South Korea	R_2	-129.900 -116.788				
Iran	R_1	-12.053 -6.558	-4.034	-3.448	-3.148	Z(t)
South Korea	R_2	-11.953 -10.652				
Number of observation			118			
Newey – West			0			
MacKinnon approximate p-value for Z (t)			0.0000			

***Source*:** Authors

- The c_{11} parameter indicates the effect of exchange market on its own, whereas the c_{12} and c_{21} parameters show the ARCH effects from the exchange market to stock market and from the stock market to exchange market, respectively.
- The g_{11} and g_{22} parameters are the GARCH (the persistence of volatility transmission) effects of each market on its own.

Based on the results presented in Table.3, among the own-mean spillovers effests (a_{ii}: i = 1, 2) only a_{22} (=0.4403) is statistically significant in Iranian economy. This provides the evidence of a positive influence on current variable of stock market arising from its first lag value. There are not any cross-mean spillovers effects from the stock market to exchange market (a_{12} and a_{21}) in two economies Among the own volatility effects (c_{ii}: i = 1, 2), both c_{11} of about 0.19 (Iran) and 0.39 (Korea) are statistically significant and much higher in the latter. When the volatility ARCH effects (c_{ij}) from the market *i* to market *j* are considered; there are volatility effects from the exchange market to stock market (c_{12}) of about -0.71 in Iranian economy compared to -0.79 in Korean economy, much higher in absolute value in the latter. Even though there are volatility effects from the stock market to exchange market (c_{21} = -0.2114) in Korean economy but these effects are not statistically significant in Iranian economy. When the volatility transmission effects from the market *i* to market *j* are investigated; the persistence of volatility

transmission effects of each market on its own (g_{11} and g_{22}) is observed in each economy. The g_{11} values of the exchange market vary from the minimum level of about -0.42 (Iran) to the maximum level of 0.71 (Korea), whereas the g_{22} values of the stock market are both positive and almost the same in two economies.

Table 3: Model Estimation Results for Iran and Korea

Parameter	Iran				Korea			
	Coefficient	Std Error	T-stat	Sig.	Coefficient	Std Error	T-stat	Sig.
α_1	-0.0072	0.0015	-4.7569*	0.0000	-0.0023	0.0028	-0.8151	0.4150
α_2	0.0077	0.0036	2.1562**	0.0311	0.0064	0.0059	1.0889	0.2762
a_{11}	-0.0555	0.0892	-0.6215	0.5342	-0.1403	0.0867	-1.6184	0.1056
a_{12}	0.0116	0.03914	0.2977	0.7659	-0.0215	0.0545	-0.3940	0.6936
a_{21}	-0.0934	0.2692	-0.3471	0.7285	0.0262	0.2176	0.1203	0.9042
a_{22}	0.4403	0.0741	5.9428*	0.0000	-0.0705	0.1110	-0.6350	0.5254
b_{11}	0.0072	0.0041	1.7484***	0.0804	0.00782	0.0056	1.3930	0.1636
b_{21}	-0.0235	0.0449	-0.5244	0.5997	-0.0358	0.0298	-1.2006	0.2299
b_{22}	0.0000	1.2540	-8.3507e-7	0.9999	0.0000	324.9557	-3.699e-10	1.0000
c_{11}	0.1937	0.1002	1.9334***	0.0532	0.3919	0.1623	2.4142**	0.0158
c_{12}	-0.7063	0.3792	-1.8623***	0.0625	-0.7938	0.3086	-2.5726**	0.0101
c_{21}	0.2725	0.0403	6.7576	0.0000	-0.2114	0.0500	-4.2262*	0.0000
c_{22}	0.1300	0.1711	0.7603	0.4471	-0.1162	0.1472	-0.7896	0.4298
g_{11}	-0.4176	0.1829	-2.283**	0.0224	0.7072	0.1046	6.7592*	0.0000
g_{12}	1.3388	0.9328	1.4353	0.1512	0.2326	0.2878	0.8081	0.4190
g_{21}	0.0538	0.1596	0.3372	0.7359	0.0134	0.0890	0.1507	0.8802
g_{22}	0.7783	0.2602	2.990*	0.0028	0.7874	0.2617	3.0088*	0.0026

***Source*:** Authors

Note: * 1%, ** 5% and *** 10% the significance levels. The indexes 1 and 2 indicate exchange and stock markets, respectively.

4. Conclusion

In present study a dynamic relationship between stock market and exchange market is examined in two Asian economies, Iran and South Korea. Applying a MGARCH-BEKK(1,1) model over the period 2002: 05) to 2012: 03, the estimated results show:

1) The spilloners effects: Among the own-mean spillovers effects (a_{ii}: i = 1, 2) only a_{22} is statistically significant in Iranian economy providing an evidence of the positive influence on current variable of stock market arising from its first lag value. There is not any cross-mean spillovers effects ($a_{ij} : i \neq j$) in two markets in each economy.

2) The ARCH volatility effects: Among the own volatility effects (c_{ii}: i = 1, 2), both c_{11} of about 0.19 (Iran) and 0.39 (Korea) are statistically significant and much higher in the latter. There are cross volatility effects ($c_{ij} : i \neq j$) from the exchange market to stock market (c_{12}) in both economies. From the exchange market to stock market, the c_{12} values of about -0.71 in Iran and -0.79 in Korea show much higher value in absolute terms in Korean economy. However, even though there is a volatility effect from the stock market to exchange market (c_{21}) in Korea but no such effect is found in Iran. Therefore, there exists a bidirectional volatility effects in two Korean exchange and stock markets.

3) The persistence of volatility transmission effects: There are no cross transmission effects between two markets ($g_{ij} : i \neq j$) in each economy. The persistence of own volatility transmission effects ($g_{ii} : i = 1,2$) are statistically significant in both economies. The g_{11} in the exchange is about -0.42 in Iran with the opposite sigh compared to about 0.71 in Korea. The own volatility transmission effects of the stock market (g_{22}) are both positive and almost the same in two economies.

The policy implication of finding is clear. The financial policymakers should watch both stock and exchange markets in two economies to prevent the bidirectional volatility effects between two markets in Korea and the unidirectional volatility from the exchange market to sock market in Iran.

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