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 price and exchange rate in two Asian countries, Iran and South Korea. A monthly time series data from 2002 (07) to 2012 (03) is used. The data is collected from the Central Bank of each country and WDI. The calculated stock return and real exchange rate are used in analysis. An econometric VECH multiple generalized autoregressive conditional heteroscedasticity (MGARCH) method is applied and the STATA software is used to analyze a bidirectional relationship between two variables in each country. Both variables are in growth rates to make sure of their stationary properties. The estimated results show no bidirectional relationship between two variables in both economies and only a unidirectional relationship from stock return to exchange rate in South Korean economy. No relationship is found between two variables in Iranian economy. When the own volatility shocks for both markets are considered, the results show that the past shocks arising from the exchange market have a stronger impact on its own future market volatility in Korean economy compared to Iranian economy. The implication of finding is that financial policymakers should watch both stock and exchange markets in Korean economy to prevent the stock market instability transitions to exchange market.

JEL Classification Numbers: G02 G15 G17

Keywords: Stock price, exchange rate, VECH MGARCH, Asian Economies.
I. 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 behaviour 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 remarks are in last section.

II. 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. 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, et al. (1997) show that the U.S. banking stock returns is very sensitive to exchange rate movements. Chiang and Yang (2003) confirm that stock returns and currency values are positively related for nine Asian markets.

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, et al. (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 bi-directional 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, et al. (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 and find a long-term equilibrium and asymmetric causal relationships (Zhao, 2010).

III. Data and Methodology:

The monthly data for two countries, Iran and South Korea, covers 2002 (07)- 2012 (03). The data is collected from the Central Bank of each country and WDI. The base year is 2010 (01). The data includes stock price indices, nominal exchange rates (NE), domestic and world consumer price indices (CPI).

The real market exchange rate (RE) is calculated as follows:

\[
RE = \left(\frac{CPI_w}{CPI_D}\right) \times NE
\]  

(1)

The USA CPI is used for the world CPI.
The stock market return at time $t$ is computed based on the current stock market price index ($P_t$) and the previous stock market price index ($P_{t-1}$) applying the following definition:

$$SR_t = \ln\left(\frac{P_t}{P_{t-1}}\right)$$

(2)

The rate changes of RE ($r_1$) and SR ($r_2$) are used in analysis followed. Figures (1) to (4) display the patterns of variables over the entire period. Table 1 summarizes the descriptive statistics of variables in both countries.

Table 1: Descriptive Statistics of Variables

<table>
<thead>
<tr>
<th></th>
<th>Iranian Exchange rate change (Ir1)</th>
<th>Korean Exchange rate change (Kr1)</th>
<th>Iranian Stock return change (Ir2)</th>
<th>Korean stock return change (Kr2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>-.0067593</td>
<td>-.0016472</td>
<td>.0157727</td>
<td>.0073257</td>
</tr>
<tr>
<td>Median</td>
<td>-.006680</td>
<td>-.002277</td>
<td>.006954</td>
<td>.014681</td>
</tr>
<tr>
<td>Maximum</td>
<td>.0553088</td>
<td>.1125281</td>
<td>.2399785</td>
<td>.126848</td>
</tr>
<tr>
<td>Minimum</td>
<td>-.0683142</td>
<td>-.1642634</td>
<td>-.1108718</td>
<td>-.2631117</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>.016634</td>
<td>.0374433</td>
<td>.0547892</td>
<td>.0658782</td>
</tr>
<tr>
<td>Skewness</td>
<td>-.3255497</td>
<td>.017109</td>
<td>.6521037</td>
<td>-.7372255</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>5.9134</td>
<td>7.115263</td>
<td>4.213184</td>
<td>4.41258</td>
</tr>
<tr>
<td>Jarque-Bera</td>
<td>44.18807</td>
<td>83.97641</td>
<td>15.73193</td>
<td>20.67342</td>
</tr>
<tr>
<td>p-value</td>
<td>0.000000</td>
<td>0.000000</td>
<td>0.000384</td>
<td>0.00032</td>
</tr>
<tr>
<td>Correlation coefficients</td>
<td>---</td>
<td>---</td>
<td>-0.0905</td>
<td>-0.4050</td>
</tr>
</tbody>
</table>
Figure 1: Stock Return Change in South Korea

Figure 2: Stock Return Change in Iran

Figure 3: Real Exchange Rate Change in South Korea
From Table 1, the mean returns for the two stock return change 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 return series over the period. The mean values for the two exchange change rates 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 a standard deviation of 0.017 compared to the Korean of 0.037, 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 absolute value of correlation coefficients of approximately 0.405, Korean stock return change and exchange rate change series are highly correlated compared to a low correlation coefficient of 0.091 in Iran.

The following general vech MGARCH model, developed by Bollerslev, Engle, and Wooldridge (1988), is applied to find the interrelationship between two markets:

\[ y_t = CX_t + \varepsilon_t, \quad \varepsilon_t = H_t^{1/2} \nu_t \]

\[ h_t = s + \sum_{i=1}^{\nu} A_i \text{vech}(\varepsilon_{t-i}, \varepsilon'_{t-i}) + \sum_{j=1}^{\varrho} B_j h_{t-j} \]  \hspace{1cm} (3)

Where,

\[ y_t \] : an \( m \times 1 \) vector of dependent variables;
C : an m × k matrix of parameters;

\( x_t \) : a k × 1 vector of independent variables, which may contain lags of \( y_t \);

\( H_t^{1/2} \) : the Cholesky factor of the time-varying conditional covariance matrix \( H_t \);

\( v_t \) : an m × 1 vector of independent and identically distributed innovations;

\( h_t \) : vech\((H_t)\);

s: an m(m + 1)/2 × 1 vector of parameters;

Ai : an m(m + 1)/2 × m(m + 1)/2 matrix of parameters; and

Bj : an m(m + 1)/2 × m(m + 1)/2 matrix of parameters.

Bollerslev, Engle, and Wooldridge (1988) argue that the general-vech MGARCH model in (3) is too flexible to fit to data, so they propose restricting the matrices Ai and Bj to be diagonal matrices. It is for this restriction that the model is known as a diagonal vech MGARCH model.

Before the model estimation, the PP unit root test is applied to make sure of the stationary of variables. Tables (2) to (5) show that all variables are stationary.

The multivariate GARCH model (3) is estimated with the diagonal VECH(1,1) specification and the STATA software.\(^1\) Table 6 shows the estimation results.

Based on the results presented in Table 6, among the own-mean spillovers (C\( ii \) for \( i = 1, 2 \)) only C11 and C22 are statistically significant in both economies, providing evidence of an influence on current of variables of exchange and stock markets arising from their first lag values. The own-mean spillovers vary from a minimum of -0.448 (Iran) to a maximum of 0.0891 (Korea). Even though there are some cross-mean spillovers effects from the stock market to exchange market (C12) and the opposite direction (C21), but only the former, and just in Korean case, is statistically significant.

\(^1\) In model (3), the p lagged value is set to one and the ht component is restricted to \( h_t = s + A_1\text{vech}(\epsilon_{t-1}\epsilon'_{t-1}) \) to demolish the non-cancavity of the likelihood function in Korean case. The ht main components are as follows:

\[
\begin{bmatrix}
  h_{11t} \\
  h_{12t} \\
  h_{21t} \\
  h_{22t}
\end{bmatrix}
= \begin{bmatrix}
  S_{11} & S_{12} \\
  S_{21} & S_{22}
\end{bmatrix}
\begin{bmatrix}
  ARCH_{11} & ARCH_{12} \\
  ARCH_{21} & ARCH_{22}
\end{bmatrix}
\text{vech}(\epsilon_{t-1}\epsilon'_{t-1})
\]
**Table 2: The r1 Unit Root Test (Iran)**

Phillips-Perron test for unit root

<table>
<thead>
<tr>
<th>Test Statistic</th>
<th>Value</th>
<th>1% Critical Value</th>
<th>5% Critical Value</th>
<th>10% Critical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z(t)</td>
<td>-12.053</td>
<td>-3.504</td>
<td>-2.889</td>
<td>-2.579</td>
</tr>
</tbody>
</table>

MacKinnon approximate p-value for Z(t) = 0.0000

**Table 3: The r2 Unit Root Test (Iran)**

Phillips-Perron test for unit root

<table>
<thead>
<tr>
<th>Test Statistic</th>
<th>Value</th>
<th>1% Critical Value</th>
<th>5% Critical Value</th>
<th>10% Critical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z(rho)</td>
<td>-64.264</td>
<td>-27.520</td>
<td>-20.772</td>
<td>-17.560</td>
</tr>
<tr>
<td>Z(t)</td>
<td>-6.558</td>
<td>-4.034</td>
<td>-3.448</td>
<td>-3.148</td>
</tr>
</tbody>
</table>

MacKinnon approximate p-value for Z(t) = 0.0000
Table 4: The r1 Unit Root Test (Korea)

<table>
<thead>
<tr>
<th>Test</th>
<th>Statistic</th>
<th>1% Critical</th>
<th>5% Critical</th>
<th>10% Critical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z(rho)</td>
<td>-129.900</td>
<td>-27.520</td>
<td>-20.772</td>
<td>-17.560</td>
</tr>
<tr>
<td>Z(t)</td>
<td>-11.953</td>
<td>-4.034</td>
<td>-3.448</td>
<td>-3.148</td>
</tr>
</tbody>
</table>

MacKinnon approximate p-value for Z(t) = 0.0000

Table 5: The r2 Unit Root Test (Korea)

<table>
<thead>
<tr>
<th>Test</th>
<th>Statistic</th>
<th>1% Critical</th>
<th>5% Critical</th>
<th>10% Critical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z(rho)</td>
<td>-116.788</td>
<td>-27.520</td>
<td>-20.772</td>
<td>-17.560</td>
</tr>
<tr>
<td>Z(t)</td>
<td>-10.652</td>
<td>-4.034</td>
<td>-3.448</td>
<td>-3.148</td>
</tr>
</tbody>
</table>

MacKinnon approximate p-value for Z(t) = 0.0000
Table 6: Estimation Results

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Iran</th>
<th>Korea</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>Std</td>
</tr>
<tr>
<td>C_{01}</td>
<td>-.0030815</td>
<td>.0017136</td>
</tr>
<tr>
<td>C_{02}</td>
<td>.0030982</td>
<td>.0056667</td>
</tr>
<tr>
<td>C_{11}</td>
<td>-.447701</td>
<td>.0613935</td>
</tr>
<tr>
<td>C_{12}</td>
<td>-.0049421</td>
<td>.0310332</td>
</tr>
<tr>
<td>C_{21}</td>
<td>.0180499</td>
<td>.2253382</td>
</tr>
<tr>
<td>C_{22}</td>
<td>-.1949094</td>
<td>.092348</td>
</tr>
<tr>
<td>S_{11}</td>
<td>.0002053</td>
<td>.0000458</td>
</tr>
<tr>
<td>S_{21}</td>
<td>-.0001894</td>
<td>.0001103</td>
</tr>
<tr>
<td>S_{22}</td>
<td>.0029461</td>
<td>.0005111</td>
</tr>
<tr>
<td>ARCH_{11}</td>
<td>.673465</td>
<td>.2589195</td>
</tr>
<tr>
<td>ARCH_{21}</td>
<td>-.0981213</td>
<td>.1334813</td>
</tr>
<tr>
<td>ARCH_{22}</td>
<td>.0690551</td>
<td>.1172649</td>
</tr>
<tr>
<td>Wald Chi2 (4)</td>
<td>70.82</td>
<td>58.63</td>
</tr>
<tr>
<td>N</td>
<td>117</td>
<td>117</td>
</tr>
</tbody>
</table>

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

Own-volatility shocks for both markets (ARCH_{11}, ARCH_{21}, and ARCH_{22}) vary from 0.0691 (Iran) to 1.0457 (Korea), indicating the presence of ARCH effects. Among these shocks, only ARCH_{11} is statistically significant in both economies. The high value of 1.0457 in Korean economy means that the past shocks arising from the exchange market (ARCH_{11}) in this economy will have the strongest impact on its own future market volatility compared to the shocks stemming from the stock market.
IV. Conclusion

In present study a dynamic relationship between stock prices and exchange rates is examined in two Asian economies, Iran and South Korea. Applying a VECH MGARCH model over the period 2002(07) to 2012(03), the estimated results show:

1) No bidirectional relationship between two variables in both economies.
2) A unidirectional relationship from stock return to exchange rate in South Korean economy.
3) No relationship between two variables in Iranian economy.
4) When the own volatility shocks are considered, the past shocks arising from the exchange market have a stronger impact on its own future market volatility in Korean economy compared to Iranian economy.

The implication of finding is that the financial policymakers should watch both stock and exchange markets in Korean economy to prevent the stock market instability transitions to exchange market.

Sources:


