Korea Economic Institute of America

ACADEMIC PAPER SERIES

KEI KOREA ECONOMIC INSTITUTE OF AMERICA | 한미경제연구소

JANUARY 17, 2017

Exchange Rate Risk, Stock Transactions and Financial Integration: The Republic of Korea and Japan

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Abstract

This paper examines the short-run and long-run relation between volatility in the real effective exchange rate and stock returns in the Republic of Korea. A trivariate vector autoregressive model is estimated in which the Japanese stock market is included as a variable representing the influence of both international and regional capital markets. All three variables, namely, stock returns in Korea and Japan and the real effective exchange rate are found to be integrated of order 1. The Johansen cointegration test indicates no long-run relation between the variables. Granger causality, however, indicates short-run bidirectional causality between volatility in the real effective exchange rate and stock returns in Korea, between volatility in the real effective exchange rate and stock returns in Japan, and also between stock returns in Korea and Japan. Thus although no long-run relationship between the variables is found to exist, Granger causality indicates a short-term relationship between the stock market and the foreign exchange market in Korea, and also regional interdependence between the stock markets in Korea and Japan. Thus exchange rate policies and stock transactions in Japan will most likely have significant short-term effects on stock transactions in Korea.

Key Words: *Cointegration, Real Effective Exchange Rate, Stock Index, Unit Root, VECM*

Introduction

In economic theory, the flow-oriented model of exchange rate behavior posits that currency movement affects a nation's international competitiveness and its balance of trade, and consequently, its real output.[1] This affects a company's current and future cash flows and its stock prices. It is generally believed that currency depreciation improves a country's trade balance – exports become cheaper, which increases aggregate demand and raises the level of economic activity. Thus there is a relationship between exchange rate and stock returns, and currency depreciation expectedly increases stock returns in the economy. The stock-oriented model emphasizes the role of capital account in the determination of a country's exchange rate. According to Adjasi and Biekpe, exchange rate equates demand and supply of financial assets such as stocks and bonds; thus, expectations of future exchange rate movements affect the prices of financial assets.[2] In the stock-oriented model, fluctuations in exchange rates affect stock prices. For arbitrage pricing theory, Rashid and Karachi postulate that a rise in the real interest rate will reduce the present value of future cash flows; consequently, the stock returns will fall.[3] But a rise in the real interest rate will increase capital inflow into an economy and cause the domestic currency to appreciate. An appreciation in the domestic currency will then result in a decrease in stock returns. Fluctuations in real interest rates affect exchange rates and stock returns, and the arbitrage pricing theory assumes that movements in exchange rates affect stock returns.

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All three models on the relation between exchange rate and stock returns postulate that exchange rate affects stock returns. Under a floating exchange rate regime, currency depreciation expectedly increases stock returns while an appreciation is expected to decrease stock returns. Although most empirical studies have provided evidence of a significant link between exchange rate and stock returns, the direction of impact of changes in exchange rate on stock returns have varied considerably across studies. As discussed in the ensuing section, the relation between exchange rate and stock returns can be either positive or negative depending on economic reasons and also some econometric factors such as the methodology used and the sample period and countries under study. According to Phylaktis and Ravazzolo, the significant relation between exchange rate and stock returns in emerging markets could be attributed to an important variable that acts as a channel through which exchange rate affects stock returns.[4] One such variable is the world capital market, often represented by the U.S. stock market.

The South Korean *won* has recently witnessed a sharp decline in its value against the U.S. dollar. South Korea receives a large fraction of total FDI inflows in Asia; thus the value of stocks traded in South Korea is essential for stable economic growth and development in the region, even more so because of the volume of foreign investment the country receives. In recent times, efforts have been made to increase political cooperation and bilateral summits have been held between Japan and South Korean stock markets. The question is, has it strengthened stock market integration between the two countries? In fact, a recent study reported weak integration Asian stock markets, even though the financial markets have become more interdependent, especially after the financial crisis in July 1997.[5] Volatility in stock returns due to fluctuations in the real exchange rate may have an adverse effect on foreign investment inflows into Korea. According to Phylaktis and Ravazzolo, foreign currency risk not only affects a domestic firm's cash flows, but also affects foreign investment transactions that are stated in terms of a foreign currency.[6] Most empirical studies have shown that exchange rate is a significant determinant of stock prices. The inconclusive evidence in existing studies on the effects of exchange rate risk necessitates the need to reinvestigate the sensitivity of stock returns to changes in the real exchange rate. From the standpoint of policy implications, it is important for the policymakers to investigate the relation in order to realize the benefits of domestic and foreign private investments. Using a more recent data from 1981-2013, this paper examines the relation between exchange rate risk and stock returns for the Republic of Korea. The paper also examines the degree of financial integration between the stock markets in Korea and Japan.

The Republic of Korea has had a floating exchange rate policy. Figure 1 shows the real effective exchange rate in the Republic of Korea over the period 1981-2013. It shows steady depreciation while the index of total share prices for all shares in Korea, depicted in Figure 2, increased over the same period. Although this appears to be consistent with economic theory, that currency depreciation is followed by an increase in stock returns, it is not possible to ascertain the association and the causality between the variables by simply observing the data. Figure 3 shows the volatility in the real effective exchange rate for Korea. Figure 4 shows the total share price index in Japan over the same period.

The removal of foreign exchange restrictions and the implementation of a floating exchange rate policy in recent years have led to an extensive empirical investigation into the relation between the stock and foreign exchange markets in emerging and developed economies. The results are generally mixed. For instance, Adjasi and Biekpe reported lack of a stable long-run relation between exchange rate and stock prices in South Africa.[7] But Mlambo et al. observed a weak relation between currency volatility and stock market for the same country.[8] The mixed and inconclusive results, therefore, necessitate further research on the relation between the two variables. This paper aims to examine the following key issues: (i) the short-run and long-run relationships between exchange rate volatility and stock returns in the Republic of Korea; (ii) the degree of integration of the stock market in Korea with the capital market in Japan; (iii) the existence of short-term causality between volatility in the real effective exchange rate and stock returns in Korea; (iv) the implications for the MNCs in investment decisions and foreign exchange exposure. The cointegration technique is applied since it addresses problems related to nonstationarity in the data when examining the relation between the variables in both levels and differences.

Literature Review

This paper builds on Phylaktis and Ravazzolo who studied the short-run and long-run relation between stock prices and exchange rates for five Pacific Basin countries, namely, Hong Kong, Singapore, Malaysia, Thailand and the Philippines.[9] They applied the cointegration technique and performed Granger causality tests for each country. They found a positive relation between the stock and the foreign exchange markets. They also found that the U.S. stock market acts as a channel for the links between the stock and the foreign exchange markets.

Numerous other studies have estimated both linear and non-linear models and examined the relationship between the real exchange rate and stock returns and also between volatility in the real exchange rate and stock returns. For example, Soenen and Hennigar reported a significantly negative relation between exchange rate and stock returns.[10] Roll used daily data on stock returns, found a positive relation between the two.[11] Chow et al. found no relation between monthly stock returns and the real exchange rate.[12] In a study of eight industrial economies, Solnik observed a negative relationship between exchange rate and stock returns.[13] Ma and Kao, studying six countries, reported a negative relationship between domestic currency appreciation and domestic stock prices for the export-dominant country.[14] A study by Choi also confirmed this relationship.[15] Muhammad and Rasheed reported long-run relationship between exchange rate and stock prices for some but not for all countries in his sample of four South Asian countries.[16] Olugbenga reported a significantly positive short-run relationship between exchange rate and stock market performance, and a significantly negative relation between the variables in the long-run.[17]

Some of the earlier studies on stock market volatility include Engle and Bollerslev.[18] In general, empirical studies on the effects of exchange rate volatility on share prices and share price fluctuations have also reported mixed results. For instance, Aggarwal and Soenan and Hennigar observed a significant impact of exchange rate volatility on share price volatility.[19] Najang and Seifent reported unidirectional causal effect from exchange rate volatility to fluctuations in share prices.[20] Ajayi et al. also reported unidirectional causality from exchange rate to share prices.[21] Vygodina reported unidirectional causality from exchange rate to volatility in stock returns.[22] According to Smyth and Nadha, the causality from exchange rate to share price volatility is unidirectional for some countries and bidirectional for others, at least in the short-run.[23] The variables are found to be independent in the long-run. On the other hand, Ozair reported little evidence of cointegration and causality of exchange rate with share prices.[24] More recent studies on the relation between exchange rate volatility and stock returns include Funyina and Sichoongwe.[25]

Most studies on the Korean economy have reported a short-term causal relation from exchange rates to stock returns even when no long-run association between the variables was found to exist. Abdalla and Murinde estimated a bivariate model using monthly data over the period 1985-1994.[26] They reported unidirectional causality from exchange rate to stock prices. Hwang reported a negative short-run relation between domestic currency devaluation and stock prices.[27] The study also reported unidirectional causality from exchange rate to stock prices for the Korean economy. Doong et al. used data over the period 1989-2003 and found that the financial variables are not cointegrated.[28] But Granger causality showed bidirectional causality between the variables for South Korea. Pan et al. used data over the period 1988-1998 and reported unidirectional causal relation from exchange rate to stock prices for Korea.[29]

Recent studies on stock market integration in Asia include Chiang et al., Cheung et al., Wang and Moore, Cheung et al., Kim and Kim, and Jeong, among others.[30]

Data and the Model

Data: Annual data is obtained from the Federal Reserve Bank of St. Louis for the sample period 1981-2013. The variables are: (i) the total share prices for all shares for the Republic of Korea; (ii) the total share prices for all shares for Japan; (iii) volatility in the real effective exchange rate based on manufacturing consumer price index for the Republic of Korea. Share price indices are determined by the stock exchange. A share price index measures how the value of the stocks in the index is changing. They exclude dividend payments. It measures the current market capitalization of the basket of shares in the index. Occasionally central banks compile share indices. In the OECD MEI database, the targeted variable for share prices is national all-share or broad indices.

The total share prices for Korea are obtained from the Korea Stock Exchange (KSE KOSPI) with the currency being the South Korean *won*. It represents the stock market index of South Korea. The total share prices for all shares in Japan are obtained from the Tokyo Stock Exchange (TSE TOPIX). It shows the trend in the stock market in Japan with the currency being the Japanese *yen*. There are three main reasons why the Japanese stock market has been considered instead of the U.S. stock market. Firstly, numerous empirical studies have already considered the U.S. stock market; however, there is hardly any comprehensive pairwise paired study on foreign exchange and stock market integration between Korea and Japan. Secondly, although efforts have been made to strengthen stock market integration between Korea and Japan, some studies have indicated weak integration between Asian stock markets. Thirdly, the inclusion of the Japanese stock market allows us to also examine the influence of both international and regional capital markets on stock transactions in the Republic of Korea.

The data on the real effective exchange rate is obtained from the Organization for Economic Co-operation and Development (OPEC). The real effective exchange rate is the weighted average of the bilateral real exchange rates. An increase in the real effective exchange rate index would imply appreciation while a decrease in the index would imply depreciation. The volatility in the real effective exchange rate is measured by the standard deviation of the real effective exchange rate from the mean.

The Model: The lack of a causal relation between real exchange rate and stock returns in a bivariate model is often attributed to the omission of an important variable from the system. The variable omitted is usually stock transactions in a foreign country, which represents the influence of the international capital market. The variable is also found to act as a channel through which the real exchange rate affects stock transactions in the domestic economy. For this reason, a trivariate model is preferred to a bivariate system.

Following Phylaktis and Ravazzolo , the long-run relation between volatility in the real effective exchange rate and the total share prices in Japan and Korea is examined by estimating a trivariate model of the following form:

(1) $-SPIK_t = a + b\,(VREX)_t + c(SPIJ)_t + \varepsilon_t$

The model in (1) shows the long-run effects of the volatility in the real effective exchange rate and changes in the total share prices in Japan on the total share prices in the Republic of Korea.

A vector error correction representation of the model in (1) with *k* lags and *r* cointegrating vectors with a linear trend in the levels of the data is given by:

(2) $\Delta Y_t = X + AY_{t-1} + \sum_{i=1}^{k-1} \varphi_i\ \Delta Y_{t-i} + \mu_t$

Estimation Method: The Dickey Fuller-Generalized Least Squares (DF-GLS) unit root test proposed by Elliott, Rothenberg and Stock is first performed to examine stationarity in each variable.[31] The DF-GLS unit root test is performed since it possesses greater power properties than the traditional ADF test. The optimum number of lags for the vector error correction model is selected by Akaike Information Criteria (AIC). The Johansen cointegration test is next performed with the optimum lag-length chosen by AIC in order to determine the maximum rank of the cointegrating matrix. If the variables are found to be cointegrated, then the VECM is to be estimated with the optimum lag-length selected by AIC and the maximum rank of the cointegrating matrix. The model is to be estimated within the Johansen framework; that is, if the maximum rank of the cointegrating matrix is *r*, then at least r^2 restrictions are to be imposed in order to determine the long-run coefficients.[32] If the variables are I(1) with no cointegration, then the short-term causality between the variables will be examined by estimating a first-order differenced VAR model. The diagnostic tests are lastly performed to examine autocorrelation, normality in error distribution and model stability.

Main Results

Unit Root Test: The optimum lag for each variable is determined by the minimum of Schwarz Criterion and Modified Akaike Information Criterion test statistics. The optimum lag length selected for each variable in level form is 1. The test is performed for models that include lags of the first-differenced detrended variables. The Schwert criterion is used to determine the maximum number of lags.[33] The null hypothesis is that the variable has a unit root. The DF-GLS statistics for each variable at levels and first-differences are reported in Table 1.

Table 1. Unit Root Test

	DF-GLS	Optimum Lag
SPIK	-3.01	1
VREX	-2.13	1
SPIJ	-2.84	1
First-Difference		
ΔSPIK	-4.84*	3
ΔVREX	-3.23***	1
ΔSPIJ	-3.64**	3

*, ** and *** in Table 1 indicate significant at 1%, 5% and 10% significance level, respectively.

Johansen Cointegration Test: The variables are I(1). Since the variables are first-difference stationary, the Johansen cointegration test is performed next. Since AIC selected a model with 1 lag, the cointegration test is performed with 1 lag. The results are reported in Table 2.

The maximum rank of the cointegrating matrix is 0; thus the model fails to reject the null hypothesis that there is no long-run relationship between the three variables.

The general form of a VAR model with k variables that are expressed as linear functions of their own lags and that of other variables is represented by:

(3) $Y_t = V + A_1 Y_{t-1} + \ldots\ldots + A_l Y_{t-l} + \mu_t$

In the equation above, Y_t is a *k x 1* vector of variables, $A_1, \ldots\ldots A_l$ are *k x k* matrices of parameters, *V* is a *k x 1* vector of parameters and μ_t follows a white noise process. The errors are distributed with mean 0 and are uncorrelated.

Since the variables are I(1) with no cointegration, a first-order differenced VAR model is estimated with 6 lags selected by AIC. The results are reported in Table 3.

In Table 3, the short-run coefficient 0.55 for the first difference in share price index in Korea at lag 5 is significant at 1% significance level; the short-run coefficients 0.38, -0.26 and 0.18 for the first differences in exchange rate volatility at lags 2, 3 and 5 are significant at 1%, 5% and 10% significance level, respectively; the short-run coefficients 0.36 and -0.42 for the first differences in share price index in Japan at lags 3 and 4 are significant at 1% significance level. Thus the effects of the past values of the variables on total share prices in Korea are mixed and mostly insignificant. Volatility in real effective exchange rate and total share prices in Japan are thus found to have both significant positive and negative effects on the total share prices in Korea.

The line of causality is examined by performing the Granger causality test. Volatility in the real effective exchange rate, for instance, will Granger cause total share prices in Korea if, given the past values of the total share prices in Korea, the past values of the real effective exchange rate volatility are useful for predicting share prices in Korea. The total share prices in Korea are regressed on its own lagged values and also on the lagged values of real exchange rate volatility. The null hypothesis that the estimated coefficients of the lagged values of real exchange rate volatility are jointly zero is then tested. The results of the Granger causality test are reported in Table 4.

The chi-square statistics reported in Table 4 are significant at 1% significance level. The results indicate bidirectional causality between volatility in the real effective exchange rate and total share prices in Korea, and between volatility in the real effective exchange rate and total share prices in Japan. Bidirectional causality is also observed between the total share prices in Korea and Japan.

Table 2. Johansen Cointegration Test

Maximum Rank	Eigenvalue	Trace Statistic	5% Critical Value
0	-	13.92*	29.68
1	0.21	6.22	15.41
2	0.16	0.59	3.76

Table 3. VAR Estimates

	Coefficient	Standard Error	Probability
$\Delta SPIK_{t-1}$	-0.08	0.19	0.69
$\Delta SPIK_{t-2}$	-0.09	0.17	0.58
$\Delta SPIK_{t-3}$	-0.26	0.16	0.10
$\Delta SPIK_{t-4}$	-0.18	0.16	0.29
$\Delta SPIK_{t-5}$	0.55*	0.16	0.00
$\Delta SPIK_{t-6}$	0.22	0.21	0.29
$\Delta VREX_{t-1}$	0.08	0.13	0.52
$\Delta VREX_{t-2}$	0.38*	0.11	0.00
$\Delta VREX_{t-3}$	-0.26**	0.12	0.03
$\Delta VREX_{t-4}$	-0.08	0.12	0.49
$\Delta VREX_{t-5}$	0.18***	0.11	0.09
$\Delta VREX_{t-6}$	0.14	0.11	0.21
$\Delta SPIJ_{t-1}$	0.05	0.13	0.72
$\Delta SPIJ_{t-2}$	0.10	0.13	0.44
$\Delta SPIJ_{t-3}$	0.36*	0.14	0.01
$\Delta SPIJ_{t-4}$	-0.42*	0.16	0.01
$\Delta SPIJ_{t-5}$	0.12	0.17	0.46
$\Delta SPIJ_{t-6}$	0.16	0.15	0.29
Constant	0.82	0.82	0.31

The short-term causality from volatility in the real effective exchange rate to total share prices in Korea indicates a close link between the real effective exchange rate index and stocks traded in Korea. An increase or decrease in the real effective exchange rate index (currency appreciation or depreciation) would lead to an increase or a decrease in stock transactions in Korea. Thus there is a short-term causal link between the stock market and the foreign exchange market in Korea. According to Phylaktis and Ravazzolo, the relaxation of foreign exchange restrictions may be a necessary condition for the link between foreign exchange and stock markets.[34] The degree of exchange rate flexibility may also have a significant role in the causal relation between the foreign exchange market and the stock market in Korea. Thus changes in the exchange rate policy will most likely have an immediate effect on stock market transactions and foreign investment in the Korean economy.

Granger causality further indicates that stock transactions in Japan have a significant effect on the local stock market in Korea. This reflects interdependence and integration of Korea's stock market with the Japanese stock market. There are several factors that influence stock market integration. As Phylaktis and Ravazzolo explained, apart from having access to capital market itself, access to local market information is necessary for international investments to take place.[35] Some determinants of market integration include regional trade openness and market development, trade balance and interest rate differential, total trade, industrial production, inflation rate, short-term interest rate, exchange rate volatility, and bilateral FDI intensity.[36] However, according to Bekaert and Harvey and Levine and Zervos, liberalization may not necessarily attract foreign investment due to home bias in equity portfolio, country-specific risks, and access to local market information on company stocks.[37] Institutional rigidities and international differences in tax laws, as discussed in Feldstein and Horioka, could affect capital mobility across countries and affect the degree of financial integration between countries.[38] According to Levine and Zervos, countries that publish information about a firm, such as its price-earnings ratio more comprehensively and internationally, will have better chances of developing a more globally integrated stock market than countries that do not make such information available to the potential investors.[39]

VAR Diagnostics: The results of the Lagrange Multiplier test for serial autocorrelation, the Jarque-Bera test for normality in error distribution, and model stability are reported in Table 5. In LM test, the null hypothesis of no autocorrelation is tested for each of the 6 lags selected by AIC. In Jarque-Bera test, the null hypothesis is that the errors are normally distributed. The stability test is also performed.

The results of the LM test for autocorrelation indicate that the chi-square statistic is less than the 10% critical value 14.68 for 9 degrees of freedom for all lags except lag 4. The results overall indicate no autocorrelation at lag order. For the Jarque-Bera normality test, the chi-square statistic 0.06 is less than the 10% critical value 4.61 for 2 degrees of freedom. This confirms that the errors are normally distributed. An R^2 value of 0.72 indicates that the model fits the data well. The stability test was also performed. All the eigenvalues were found to lie inside the unit circle. Thus the VAR model was found to satisfy the stability condition.

Table 4. Granger Causality

	ΔSPIK	ΔVREX	ΔSPIJ
ΔSPIK	-	24.29* (0.00)	21.49* (0.00)
ΔVREX	39.89* (0.00)	-	16.90* (0.01)
ΔSPIJ	108.54* (0.00)	88.83* (0.00)	-

Table 5. The Model Diagnostics

LM	Chi-square Statistic	Degrees of Freedom	Probability
Lag 1	4.32	9	0.89
Lag 2	10.85	9	0.29
Lag 3	12.15	9	0.21
Lag 4	14.89	9	0.09
Lag 5	6.69	9	0.67
Lag 6	12.99	9	0.16
Normality	chi-square statistic	degrees of freedom	probability
Jarque-Bera	0.06	2	0.97
R^2: 0.72			

Conclusion

This paper investigates the cointegrating and causal relationships between volatility in the real effective exchange rate and stock transactions in the Republic of Korea. The effects of changes in stock transactions in Japan on the stock market in Korea are also examined. Although the variables are found to be integrated of order one, the Johansen cointegration test does not support long-run relationship between the variables. Thus the variables are found to be I(1) with no cointegration. A first-order differenced VAR model is estimated. Granger causality indicates short-run bidirectional causality between volatility in the real effective exchange rate and stock transactions in Korea. The results, therefore, indicate a close association between the stock market and the foreign exchange market in Korea. Granger causality also indicates short-run bidirectional causality between stock transactions in Korea and Japan. This provides evidence of stock market interdependence and financial integration of the stock market in Korea with the Japanese capital market.

The Republic of Korea has had a floating exchange rate policy over the years. As far as policy implications are concerned, if flexibility in the real effective exchange rate plays a crucial role in the close association between the foreign exchange and stock markets in Korea, then the Korean government can use the exchange rate as a policy instrument to increase foreign portfolio investment in the country. Exchange rate flexibility could therefore play a significant role in the link between the stock markets in Korea and Japan. The design and implementation of appropriate monetary and fiscal policies may further integrate the Korean stock market with the international capital market and attract more foreign investment. Also, cooperation with foreign stock markets may further increase the inflow of foreign capital into Korea and promote sustainable economic growth and development in the region in the long-run. Since exchange rate volatility significantly affects stock returns, it might be necessary for the central bank to intervene when there is excessive exchange rate volatility to restore stability and investors' confidence. According to Sichoongwe, it might also be necessary to use efficient hedging instruments to eliminate the negative effects of exchange rate volatility.[40]

It might be interesting to include more control variables and examine the sensitivity of the short-run and long-run dynamics to the presence of structural breaks in the data. Studies that have examined the relation between exchange rate and stock returns with or without structural breaks in the data have reported short-term causal relation between the stock market and the foreign exchange market. Therefore, the results are consistent with the findings in the existing literature. In Phylaktis and Ravazzolo, the Asian Financial Crisis had only a temporary effect on the long-run relation between the stock market and the foreign exchange market in the five Pacific Basin countries.[41] Nonetheless, it might still be interesting to account for the Asian Financial Crisis and global economic recession for a more robust inference.

Figure 1. The Republic of Korea Real Effective Exchange Rate Index: 1981-2013

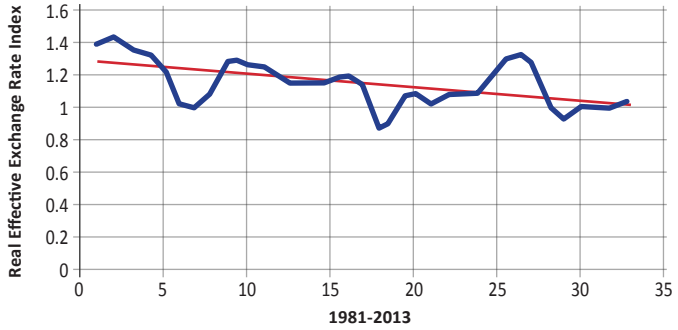


Figure 2. Total Share Price Index in the Republic of Korea: 1981-2013

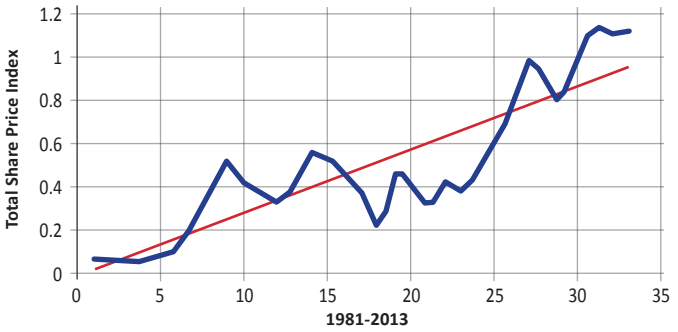


Figure 3. Volatility in the Republic of Korea Real Effective Exchange Rate Index: 1981 2013

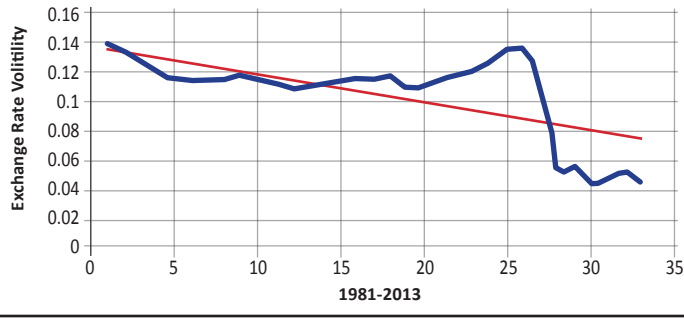
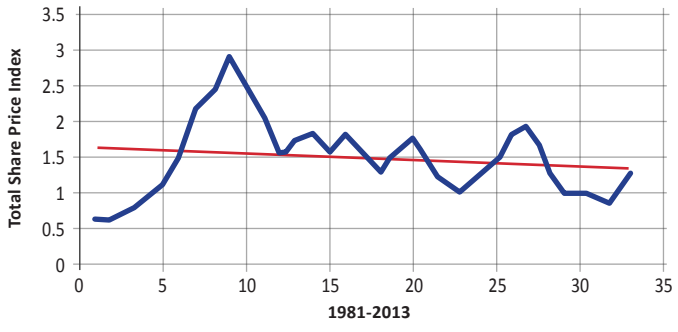


Figure 4. Total Share Price Index in Japan: 1981-2013



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