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Long-run and Short-run Causality from Exchange Rates to the Korea Composite Stock Price Index*

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Abstract

The paper aims to test long-term and short-term causality from four exchange rates, the Korean won/$US, the Korean won/Euro, the Korean won/Japanese yen, and the Korean won/Chinese yuan, to the Korea Composite Stock Price Index in the presence of several macro-economic variables using monthly data from January 1986 to June 2018. The results of Johansen cointegration tests show that there exists at least one cointegrating equation, which indicates that long-run causality from an exchange rate to the Korean stock market will exist. The results of vector error correction estimates show that: for long-term causality, the coefficient of the error correction term is significant with a negative sign, that is, long-term causality from exchange rates to the Korean stock market is observed. For short-term causality, the coefficient of the Japanese yen exchange rate is significant with a positive sign, that is, short-term causality from the Japanese yen exchange rate to the Korean stock market is observed. The coefficient of the financial crises i.e. 1997-1999 Asian financial crisis and 2007-2008 global financial crisis on the endogenous variables in the model and the Korean economy is significant. The result indicates that the financial crises have considerably affected the Korean economy, especially a negative effect on money supply.

Keywords: Stock Index, KOSPI, Exchange Rates, Japanese Yen, Financial Crisis, Causality.

JEL Classification: G15, F31, E44, F37, G01.

1. Introduction

Much of the existing research regarding exchange rates in Asia has focused on their volatility and relationship with trade and prices. More specifically, there are asymmetric effects of the exchange rate on domestic corporate goods prices when the exchange rate is more volatile. In Japan, Murase (2013) reports that the degree of exchange rate pass-through to the aggregated corporate goods price index is higher than the change of the corporate goods price index and more gradually adjusted in a higher exchange rate volatility regime. Ghosh and Rajan (2009) report that an exchange rate pass-through in Korea with respect to the U.S. dollar is higher than with respect to the Japanese yen. Nishimura and Hirayama (2013) report that Japan's exports to China are not affected by either the exchange rate volatility or the level of the exchange rate, but China's exports to Japan are negatively influenced during the reform period of the Chinese yuan exchange rate regime. In addition, Wang, Lin, and Yang (2012) have suggested that the real appreciation of Chinese yuan has no overall long-run impact on China's trade balance. Besides, Baak (2012)

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has argued that the real effective exchange rate of the Korean won is misaligned from its equilibrium value, which leads to drastic changes in Korea's trade pattern and trade partner weights. The theoretical line pursued in the aforementioned studies is that the relationship between exchange rates and stock prices can be correlated, especially when we consider recent large cross-border movements of funds and investments.

With the ongoing development of equity markets, two theories about the dynamic relationship between exchange rates and stock prices are the traditional approach and the portfolio approach. These approaches have long been discussed but not yet resulted in consensus. The traditional approach claims that depreciation of the domestic currency makes local firms more competitive, leading to an increase in their exports and consequently higher stock prices. This implies a positive correlation between exchange rates and stock prices. The traditional approach suggests that the fluctuation of exchange rates lead to the changes in stock prices. On the contrary, the portfolio approach argues that an increase in stock prices induces investors to demand more domestic assets and thereby causes an appreciation in the domestic currency. Thus, changes in stock prices lead to fluctuation of exchange rates and they are negatively related.

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 rates, current investment and consumption decisions (Zhao, 2010). In the floating exchange rate system, the exchange rate is essentially determined by a country's current account balance or trade balance. As a result, the exchange rate fluctuation affects international competitiveness and trade balance to some extent. Consequently, it affects real income and stock prices, especially the stock price of export oriented enterprises. The flow-oriented model (Dornbusch & Fisher, 1980) claims a positive linkage between exchange rates and stock prices. Local currency depreciation would lead to greater competitiveness of domestic firms given that their exports will be cheaper in international trade. Higher exports will increase the domestic income and hence the firms' stock prices will go up since they are evaluated as the present value of the firms' future cash flows.

The stock-oriented model (Branson, Halttunen, & Masson, 1977) of exchange rates specifies the exchange rate as serving to equate the supply and demand for assets such as stocks and bonds. This model determines the exchange rate dynamics by giving the capital account a pivotal 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 price movements of the financial assets. Therefore, stock price innovations may affect, or be affected by, exchange rate dynamics (Zhao, 2010). As a result, if the common factors influence the two variables, stock price innovations may be reciprocally associated with the exchange rate dynamics or be influenced by the exchange rate behavior.

The research goals of this study are to fill the gap in the literature and to provide new evidence on both the short-run and long-run causal relationship between exchange rates and stock prices in the Korean stock market. The purpose of this study is to test for long-run and short-run causality from four exchange rates, i.e. the Korean won/$US, the Korean won/Euro, the Korean won/Japanese yen, and the Korean won/Chinese yuan, to the Korea Composite Stock Price Index in the presence of several macro-economic variables using monthly data from January 1986 to June 2018.

2. Literature Review and Hypotheses

2.1. Long-run Relationship between Exchange Rates and Stock Prices

Previous studies have addressed different findings regarding the causal relations between stock prices and exchange rates in various countries. For example, Nieh and Lee (2001) found no long-run relationship between stock prices and exchange rates in the Group-7 countries. Yau and Nieh (2006) suggested no clear long-run relation between the new Taiwan dollar and the Japanese yen exchange rates and the stock prices of Taiwan and Japan. Zhao (2010) did not find a stable long-run relationship between the Chinese yuan real effective exchange rates and stock prices. Ramasamy and Yeung (2002) indicated inconsistent results for bidirectional causality between stock prices and exchange rates for six Asian countries over the period of 1995 and 2001. Kutty (2010) found that stock prices Granger caused exchange rates in the short run but there was not a long-run significant relationship in Mexico between January 1989 and December 2006. Other studies from Griffin and Stulz (2001), Fernandez (2006), Fernandes (2009), Hartmann and Pierdzioch (2007), and Zhao (2010) suggest no relationship between exchange rates and stock prices.

On the other hand, the long-run relationship has been confirmed in some studies. For example, Lee and Zhao (2014) report that there exists negative long-run causality from foreign exchange rates to the Shanghai Stock Exchange Composite Index using monthly data from January 2002 to December 2012 of the People's Republic of China. Yau and Nieh (2009) found a long-run and asymmetric causal relationship between the exchange rates of the new Taiwan dollar and the Japanese yen and their stock prices in Japan and Taiwan. Whether empirically or theoretically, the above studies have suggested a significant relationship between exchange rates and stock prices. However, the results have been mixed for the sign and causal direction between exchange rates and stock prices. Thus, the following hypothesis is advanced:

Hypothesis 1: Exchange rates lead stock price dynamics in the long-run in the Korean stock market.

2.2. Short-run Relationship between Exchange Rates and Stock Prices

Phylaktis and Ravazzolo (2005) employed cointegration and multivariate Granger causality tests that resulted in positive short-run causality between stock prices and exchange rates in some Pacific Basin countries. Aloui (2007) indicated that movements of stock prices affect the exchange rate dynamics for the two periods pre- and post-Euro in the United States and Western European markets. Pan, Fok and Liu (2007) reported a causal relation from exchange rates to stock prices for East Asian countries. Yang and Doong (2004) suggested exchange rate changes directly impacted future changes of stock prices for the Group-7 countries from 1979 to 1999. Nandha and Hammoudeh (2007) argued that stock prices were affected by changes in the exchange rate for nine Asia-Pacific countries while Wu (2001) showed Singapore dollar exchange rates Granger caused stock prices. Further research emphasizing a positive relationship between exchange rates and stock prices can be found in Chiang and Yang (2003), Ratanapakorn and Sharma (2007), Kolari, Moorman, and Sorescu (2008), Aydemir and Demirhan (2009), Ning (2010), and Eichler (2011). Mun (2007) specified that higher exchange rate variability mostly increases local stock market volatility, but decreases volatility for the United States stock markets. Exchange rate exposure has negative and significant impact on emerging market stock returns in a study by Chue and Cook (2008) while the S&P 500 stock price is negatively related to the real exchange rates in Kim (2003)'s research. Lee and Zhao (2014) report that there exists negative short-run causality from foreign exchange rates i.e. the Chinese yuan/the Korean won and the Chinese yuan/the Japanese yen, to the Shanghai Stock Exchange Composite Index using monthly data from January 2002 to December 2012 of the People's Republic of China. Thus far, the relationship between stock prices and exchange rates is still inconclusive. East Asian countries have strong economic relationships with each other within the intraregion as well as the United States and European countries (Ogawa & Yang, 2008). Therefore, further study is needed to elucidate the causality between stock prices and exchange rates. Hence:

Hypothesis 2: In the short-run, the stock price dynamics in the Korean stock market (KOSPI) are affected by the nominal exchange rates of the Korean won per the U.S. dollar (USD), the Korean won per the Euro (EUR), the Korean won per the Japanese yen (JPY) and the Korean won per the Chinese yuan (CNY).

2.3. The Impact of Global Financial Crises on Stock Market Returns

The linkage between exchange rates and stock prices vary across economies with respect to exchange rate regimes, the trade size, the degree of capital control and the size of equity market (Pan et al., 2007). Mercereau (2006) suggested that the financial structure of an equity market influenced its real exchange rate, as well as the volatility of this exchange rate, whereas Walid, Chaker, Masood, and Fry (2011) asserted that the stock price volatility responded asymmetrically to events in the foreign exchange market. Diamandis and Drakos (2011) found that there is a significant long-run relationship between the local stock market and the exchange rate market, but that the stability of the relationship is affected by financial and currency shocks such as the Mexican currency crisis in 1994 and the global financial crisis from 2007 to 2009. In addition, the process of creating the Mercosur between Argentina, Brazil, Paraguay and Uruguay in Latin American countries led to the local currency devaluation. These exchange rate movements have substantial negative impact on the respective stock prices (Allegret & Sand-Zantman, 2009; Alvarez-Plata & Schrooten, 2004; Camarero, Flores, & Tamarit, 2006).

In spite of existing coupling-decoupling effect, some researchers find markets integrate immediately after financial crisis. For example, Kim, Lee and Park (2011) claimed that after the Asian financial crisis of 1997-1998, the degree of both regional and global dependence have increased drastically. Latin America also experience financial crisis shortly after the end of Asian financial crisis. Frijns, Tourani-Rad, and Indriawan (2012) suggested that Latin American countries integrate largely after the dot-com bubble. Their results are line up with empirical results of Liu and Wan (2012)'s research, which shows there are neither linear nor nonlinear causality between Shanghai Composite Index and exchange rates before current financial crisis, but exchange rate can either linearly or nonlinearly impact Shanghai Composite Index after that financial crisis. Empirical evidence from these three research might imply that if there are negative or positive correlations between exchange rate and stock prices, the strength of these correlations may be enhanced after financial crises.

Due to geographic factors, the relation between stock prices and exchange rate is observed regionally within a specific period of time. According to Pan et al. (2007), during the period of Asian financial crisis, causality from exchange rates to stock prices is founded in Hong Kong, Japan, Korea, Singapore, Taiwan and Thailand, except Malaysia; while no causality from stock prices to exchange rate has been observed in countries mentioned above. Nonetheless, Hatemi-J, and Roca (2005) reported that the two variables are significantly linked in the non-crisis period, but not at all during the 1997 Asian financial crisis period for the Association of Southeast Asian Nations (ASEAN) countries. Choi and Park (2008) found no evidence that interest rate differentials caused spot exchange rates in Indonesia, Korea and Thailand during the 1997 Asian financial crisis. Furthermore, Japanese foreign direct investment declined with a depreciation of the Japanese yen against host country currencies in Asia but with little effect from the 1997 Asian financial crisis (Takagi & Shi, 2011). On the other hand, Liao, Chu, and You (2011) examined 30 Taiwan categorical stock indexes and 13 historic data of foreign exchange index, and found a significantly inverse correlation between them. Moreover, Liao et al. (2011) also suggested that the foreign exchange correlation rules should be examined and discussed into two categories: appreciation term and depreciation term. As a complement to the previous points, Fung and Liu (2009) discovered that a real depreciation of the New Taiwanese dollar led to an increase in exports, domestic sales, total sales and productivity during the 1997 Asian financial crisis.

Global financial shocks impacted exchange rate and stock prices simultaneously as well. Dooley and Hutchison (2009) evaluated the transmission effect of U.S. subprime crisis to emerging economies and found widely insulation and decoupling effect in emerging economies during early 2007 and mid 2008. But quickly after summer 2008, the linkages between exchange rate and stock prices re-appear dramatically. To be noticed, the timing of linkages re-emergence is uniform and remarkable within most of countries in which they observe. In addition, with much specification, Wen, Wei, and Huang (2012) found contagion effect between crude oil and U.S./Chinese stock market during most recent financial crisis. Hence, exchange rates and stock prices are correlated in a complicated manner (Kim, Yoon, & Kim, 2004; Tastan, 2006). Market interactions may destabilize stock markets, but may also play a stabilizing effect on the exchange rate market (Dieci & Westerhoff, 2010). In light of these findings, the following hypothesis is developed:

Hypothesis 3: The global financial crises of 1997-1998 and 2007-2009 have impacted the stock price dynamics in the Korean stock market.

3. Empirical Specification

Engle and Granger (1987) and Granger (1988) reported that if two or more variables are cointegrated, there always exists a corresponding error correction term in which the short-run dynamic of the variables in the system are influenced by the deviation from equilibrium. In this case, a vector error correction (VEC) model is formulated to reintroduce the information lost in the differencing process, thereby capturing long-run dynamics as well as short-run dynamics. The VEC model implies that changes in one variable are a function of the level of disequilibrium in the cointegrating relationship (captured by the error correction term), as well as changes in other explanatory variables. Thus, the VEC model is useful for capturing both the short-run and the long-run dynamics when the variables are cointegrated.

The following equation illustrates a multivariate vector autoregressive model with the error correction term. This equation will be used to test short-run and long-run Granger causation from exchange rates to the Korean stock market price.

$$\begin{aligned}
\Delta \ln KOSPI_t &= \alpha_1 + \theta FC_1 + \sum_{j=1}^{n-1} \beta_{1j} \Delta \ln KOSPI_{t-j} + \sum_{j=1}^{n} \beta_{2j} \Delta \ln USD_{t-j} \\
&+ \sum_{j=1}^{n} \beta_{3j} \Delta \ln EUR_{t-j} + \sum_{j=1}^{n} \beta_{4j} \Delta \ln JPY_{t-j} \\
&+ \sum_{j=1}^{n} \beta_{5j} \Delta \ln CNY_{t-j} + \sum_{j=1}^{n} \beta_{6j} \Delta \ln M2_{t-j} + \sum_{j=1}^{n} \beta_{7j} \Delta \ln CPI_{t-j} \\
&+ \sum_{j=1}^{n} \beta_{8j} \Delta \ln INT_{t-j} + \zeta_1 ECT_{t-1} \\
&+ \varepsilon_{1t}
\end{aligned}$$

where:

Δ indicates the difference operator;

α is the deterministic component;

Θ, β and ζ denote the parameters to be estimated;

ε_t follows stationary random errors with mean zero, that is, white noise;

j is the lag length;

t represents 1, 2, 3, …, *n* observation;

ECT_t is the error correction term obtained from the cointegrating vectors deriving from the long-run cointegrating relationship via the Johansen maximum likelihood procedure.
FC represents an exogenous variable of the global financial crises of 1997-1998 and 2007-2009.
M2 is the broad definition of money supply.
CPI refers to the inflation rate.
INT represents the interest rate.

The long-run causality is indicated by the significance of t-statistics of the lagged error correction term (i.e. by testing null hypothesis: $\zeta = 0$). The asymptotic variance of the estimator is estimated so that the t-statistics have asymptotic standard normal distribution. Asymptotic t-statistics can be interpreted the same way as t-statistics. They are used to interpret the statistical significance of coefficients of the lagged error correction term.

4. Data and Methodology

This section describes the data and outlines the methodology used in the selection of indicators and the normalization of data. The sample is restricted to the period in which monthly data are available from January 1986 to June 2018 (390 observations). All of the monthly time series data below has been collected and retrieved from the Economic Statistics System database sponsored by the Bank of Korea.

4.1. Endogenous Variables

***Korea Stock Exchange**.* The Korea Composite Stock Price Index (symbol: KOSPI) is used as a proxy of the Korean stock market prices. This major stock market index tracks the general performance of all common shares listed on the Korean Stock Exchange. The KOSPI index is a capitalization-weighted index of all common shares on the Korean Stock Exchange. The index was developed with a base value of 100 as of January 4, 1980. Monthly average of this index is used in this study.

Foreign Exchange Rates. Based on the volume of international trade with South Korea, four major exchange rates are selected: the Korean won per the U.S. dollar (USD), the Korean won per the Euro (EUR), the Korean won per the Japanese yen (JPY) and the Korean won per the Chinese yuan (CNY). The time series data is a monthly adjusted average. In effect, USD, EUR, JPY and CNY are the logarithm of the nominal exchange rate of Korean won per U.S. dollar, Euro, Japanese yen and Chinese yuan, respectively.

Macroeconomic Variables. Money supply (M2), inflation, and short-term interest rates are included in the model to address the omitted variable bias. In the empirical model, M2 is the logarithm of changes in the broad definition of money supply. Inflation is the logarithm of the consumer price index (CPI), a proxy of inflation rates. Interest rates (INT) are the logarithm of the short-term interest rate i.e. Certificate of Deposit 90 days.

4.2. Exogenous Variable

Global Financial Crises of 1997-1998 and 2007-2009*.* The global financial crises of 1997-1998 and 2007-2009 may cause structural breaks in the trend of stock prices in the Korean stock market, see Figure 1.

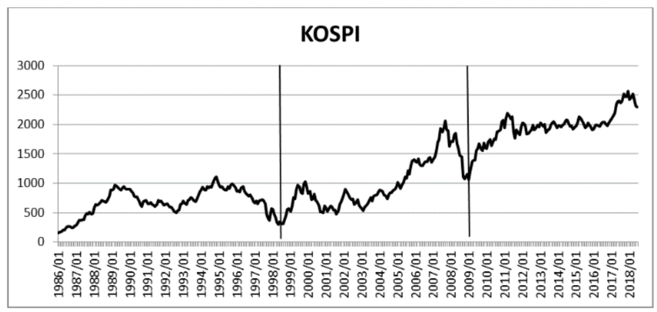

Figure 1: The KOSPI and Global Financial Crises of 1997-1998 and 2007-2009

Because the global financial crisis would introduce some changes in the implementation of monetary policy, for example, from money targeting to interest rate targeting, this would introduce substantial instability in the system. An exogenous variable is used to examine the impact of the global financial crises of 1997-1998 and 2007-2009 on the Korean stock market. An exogenous variable (i.e. a financial crisis) is assumed to have systematically affected changes in the endogenous variables in the model (Brahmasrene, Huang, & Sissoko, 2014). A dummy variable with a value of zero will cause the variable's coefficient to disappear, and a dummy with a value one will cause the coefficient to act as a supplemental intercept in the regression model. Hence, the global financial crisis variable equals one if the period falls on either between January 1997 and June 2000 or between August 2006 and December 2010, and zero otherwise.

4.3. Normalization and Transformation

The normalization of the data is necessary to transform the values to the same unit of measurement since KOSPI is presented as the base value of 100, while exchange rates are presented in the Korean won. Therefore, transformation into a natural log mitigates possible distortions of dynamic properties of the series. Log transformation is a preferred method since each resulting coefficient in the regression equation represents elasticity, which is the ratio of the incremental change of the logarithm of a function with respect to an incremental change of the logarithm of the argument.

Selected tests on time series data as prescribed in the references in each section below are necessary for statistical accuracy and to avoid spurious results. To ascertain the order of integration of the variables, this study applied the augmented Dickey-Fuller (Dickey & Fuller, 1981) unit root test and the Phillips–Perron (Phillips & Perron, 1988) test. The augmented Dickey-Fuller test assumes the errors to be independent and have constant variance while the Phillips–Perron test allows for fairly mild assumptions about the distribution of errors. The two unit root tests are carried to test the null hypothesis of the unit root in the level and the first difference of the variables. All test equations were tested by the method of least squares, including an intercept and no time trend in the model. In the unit root tests, an optimal lag in the tests is automatically selected based on Schwarz information criterion and the lag length in the tests is automatically selected based on the Newey-West estimator using the Bartlett Kernel function.

Table 1 reports the results of the two unit root tests. Table 1 indicates the null hypothesis of a unit root cannot be rejected in the level for KOSPI, USD, JPY, EUR and CNY. After first differencing, all null hypothesis of a unit root is rejected at the one percent significance level for these variables. The results in Table 1 unanimously confirm that all variables are integrated of order one or *I(1).*

Table 1: Results of Unit Root Test

Test Method	**Augmented Dickey-Fuller Test**		**Phillips–Perron Test**	
Variable	Level	1st difference	Level	1st difference
KOSPI	-1.194	-12.175***	-1.103	-12.023***
USD	-2.499	-10.353***	-2.453	-8.189***
JPY	-1.911	-9.388***	-1.865	-8.226***
EUR	-1.535	-9.731***	-1.312	-9.625***
CNY	-2.198	-10.271***	-1.890	-8.165***
M2	1.841	-3.447**	-0.103	-20.186***
CPI	-2.587	-11.738***	-2.773	-9.894***
Interest	-1.380	-11.078***	-1.489	-11.235***

Probability values for rejection of the null hypothesis of a unit root are employed at the 0.05 level (**, $p < 0.05$ and ***, $p < 0.01$).

Cheung and Ng (1998) reported that the Johansen approach is more efficient than the Engle-Granger single equation test method because the maximum likelihood procedure has large and finite sample properties. The Johansen's approach (1988) derives maximum likelihood estimators of the cointegrating vectors for an autoregressive process with independent errors. The Johansen cointegration test represents each variable as a function of all the lagged endogenous variables in the system. It uses two ratio tests, a trace test and a maximum eigenvalue test, to examine the number of cointegration relationships. Both tests could be used to determine the number of cointegrating vectors present, although they do not always indicate the same number of cointegrating vectors.

Table 2 reports the results of the Johansen cointegration test. The model is tested by the method of least squares. The regression model allows for a linear deterministic trend in data and includes the intercept but no trend in the vector autoregressive model. Trace test statistics indicate that at least four cointegrating equations exist at the 0.05 level while maximum eigenvalue test statistic indicates that at least one cointegrating equation at the 0.01 level. The results of the Johansen cointegration test confirm that there exists cointegration between stock prices and foreign exchange rates in the Korean stock market. In this case, an unrestricted vector autoregressive model would not be an effective option for testing the short-run and long-run dynamics.

Table 2: Results of Johansen Cointegration Test

Number of cointegration (r)	**Trace Statistic**	**Maximum Eigen Statistic**
r = 0	207.592***	64.013***
r ≤ 1	143.579***	40.735
r ≤ 2	102.844***	32.981
r ≤ 3	69.862**	29.209
r ≤ 4	40.652	15.847
r ≤ 5	24.804	12.605
r ≤ 6	12.199	8.023
r ≤ 7	3.179	3.179

Probability values for rejection of the null hypothesis of no cointegration are employed at the 0.05 level (**, $p < 0.05$ and ***, $p < 0.01$).

Equation: LOG_KOSPI = LOG_USD LOG_EUR LOG_JPY LOG_CNY LOG_M2 LOG_CPI LOG_INT

5. Empirical Results

Statistical inference is sensitive to parameter instability, serial correlation in residuals and residual skewness. Table 3 reports the results of VEC estimates, model diagnostic tests and residual diagnostic tests. Skewness of the series is not significantly different from a normal distribution. Histogram normality Jarque-Bera test (null hypothesis: residuals are multivariate normal) is not rejected. Breusch-Godfrey serial correlation Lagrange multiplier or LM test (null hypothesis: no serial correlation at lag order 2) is not rejected. Heteroskedasticity test (null hypothesis: no autoregressive conditional heteroskedasticity or ARCH effect at lag order 1) is not rejected. Thus, this model yields acceptable results. There are considerably fewer outliers and the fluctuation bands are smaller (Figure 2).

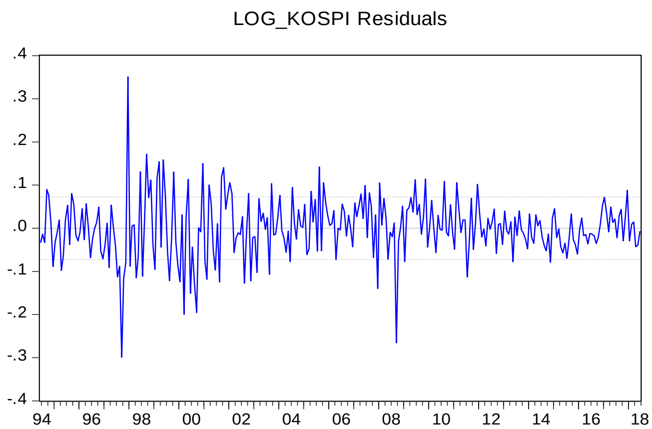

Figure 2: Graph of KOSPI Standardized Residuals

The long-run causality is determined by the error correction term. If the coefficient of the error correction term is significant, then it indicates the evidence of the long-run causality from the explanatory variables to the dependent variable (Toda & Phillips, 1993, 1994). This contains the long-run causal relationship information because it is derived from the cointegrating equation. Table 3 reports the results of VECM estimates. The significance of the coefficient of ECT(t-1) indicates that the lagged structure of ECT(t-1) is unstable, that is, the ECT has a negative effect on the Korean stock market in the long-run dynamics (see Figure 3).

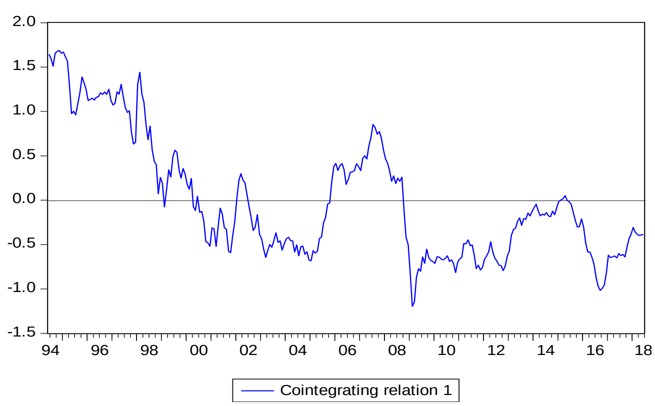

Figure 3: Cointegration Graph of the Cointegrating Equation

Table 3 reports the results of VECM estimates. Recall *hypothesis 1* that exchange rates lead to stock price dynamics in the long-run. For the long-run causality, the results of VEC estimates indicate that the coefficient of the error correction term is significant at the 0.01 level. The results indicate that exchange rates have caused a negative effect to KOSPI in the long-run. The observation confirms that the long-run causality from exchange rates to the Korean stock market exists.

Table 3: Results of Vector Error Correction(VEC) Estimates

	Endogenous variables: Lag order in ( )	**VEC model 1 (including Exogenous crisis)**	**VEC model 2 (excluding Exogenous crisis)**
	Dependent variable: ΔKOSPI(t)	Coefficient t-statistics in [ ]	Coefficient t-statistics in [ ]
Long-run dynamics[1]	ECT_{t-1} : error correction term	-0.133 [-4.477]***	-0.111 [-3.877]***
Short-run dynamics[2]	ΔKOSPI(t-1)	0.152 [2.367]**	0.147 [2.257]**
	ΔKOSPI(t-2)	0.052 [0.792]	0.053 [0.805]
	ΔUSD(t-1)	-0.603 [-0.630]	-0.401 [-0.409]
	ΔUSD(t-2)	-0.956 [-0.979]	-0.663 [-0.668]
	ΔEUR(t-1)	-0.202 [-1.031]	-0.295 [-1.491]
	ΔEUR(t-2)	0.082 [0.430]	0.039 [0.201]
	ΔJPY(t-1)	0.354 [2.081]**	0.394 [2.154]**
	ΔJPY(t-2)	0.099 [0.554]	0.109 [0.598]
	ΔCNY(t-1)	0.702 [0.725]	0.472 [0.478]
	ΔCNY(t-2)	0.597 [0.604]	0.266 [0.264]
	ΔM2(t-1)	-0.187 [-0.202]	0.029 [0.030]
	ΔM2(t-2)	-1.743 [-1.924]**	-1.407 [-1.541]
	ΔCPI(t-1)	0.196 [0.166]	0.048 [0.040]
	ΔCPI(t-2)	0.623 [0.532]	0.446 [0.375]
	ΔInterest(t-1)	-0.099 [-1.118]	-0.114[-1.279]
	ΔInterest(t-2)	0.024 [0.256]	0.003 [0.039]
	Constant	0.003 [0.337]	0.008 [0.873]
Exogenous variable	Financial crisis	0.022 [2.118]**	
Model diagnostic tests	R-squared	= 0.182	= 0.164
	Adjusted R-squared	= 0.124	= 0.109
	F-statistic	= 3.157***	= 2.960**

The probability value for rejection of the null hypothesis is employed at the 0.05 level (** $p < 0.05$ and ***, $p < 0.01$).

[1] Long-run dynamics equation: D(LOG_KOSPI) = C(1)*(LOG_KOSPI(-1) - 2.54022773023*LOG_JPY(-1) - 0.683868506597*LOG_EUR(-1) + 2.4458706773*LOG_CNY(-1) - 1.41659830345*LOG_M2(-1) + 1.13601497656*LOG_CPI(-1) + 0.72038134553*LOG_INT(-1) + 16.8871537394)

[2] Short-run dynamics equation: D(LOG_KOSPI) = C(3)*D(LOG_KOSPI(-1)) + C(4)*D(LOG_KOSPI(-2)) + C(5)*D(LOG_USD(-1)) + C(6)*D(LOG_USD(-2)) + C(7)*D(LOG_JPY(-1)) + C(8)*D(LOG_JPY(-2)) + C(9)*D(LOG_EUR(-1)) + C(10)*D(LOG_EUR(-2)) + C(11)*D(LOG_CNY(-1)) + C(12)*D(LOG_CNY(-2)) + C(13)*D(LOG_M2(-1)) + C(14)*D(LOG_M2(-2)) + C(15)*D(LOG_CPI(-1)) + C(16)*D(LOG_CPI(-2)) + C(17)*D(LOG_INT(-1)) + C(18)*D(LOG_INT(-2)) + C(19)

The short-run causality in the VEC model can be tested by the block exogeneity Wald test. The block exogeneity Wald test in the VEC system provides Chi-square statistics of coefficients on the lagged endogenous variables. These are used to interpret the statistical significance of coefficients of the endogenous variables. The hypothesis in this test is that the lagged endogenous variable does not Granger cause the dependent variable. *Hypothesis 2* states that in the short-run, the stock price dynamics in the Korean stock market (KOSPI) are affected by the nominal exchange rates of the Korean won per the U.S. dollar (USD), the Korean won per the Euro (EUR), the Korean won per the Japanese yen (JPY) and the Korean won per the Chinese yuan (CNY). For the short-run causality, the results support hypothesis 2 for the Japanese yen only. The null of hypothesis can be rejected at the 0.05 level, which means the nominal exchange rate of the Korean won per the Japanese yen leads positively stock price dynamics in the short–run in the Korean stock market.

For *hypothesis 3* that the global financial crises of 1997-1998 and 2007-2009 have impacted the stock price dynamics and the Korean economy, the result of VEC estimates indicates that the coefficient of the exogenous variable is significant at the 0.05 level. The observation confirms that the global financial crises and/or external shocks have caused instability in the VEC model, that is, the financial crises have affected changes in the endogenous variables in the VEC model, especially a significant negative effect on money supply. Thus, the significance of the coefficient of the exogenous variable in VEC model 1 indicates that the endogenous variables are affected by both the exogenous shock and their own dynamics in the VEC model. When compared to the results of VEC model 2, the results of two VEC models are very similar in terms of their signs and weights, with only exception of money supply(M2(t-2)). The observation suggests that the impact of the global financial crises on the endogenous variables in the tested VEC model has been marginalized, with reservation on money supply.

In addition to the findings corresponding to the above hypotheses, the impulse responses and variance decomposition may be noteworthy in their impact. A shock to the *j*-th variable not only directly affects the *j*-th variable but is also transmitted to all of the other endogenous variables through the dynamic (lag) structure of the vector autoregressive. The effects of the shocks on the endogenous variables can be assessed by estimating impulse responses and variance decomposition functions. An impulse response function traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables. Since innovations are usually correlated, it may be viewed as having a common component that cannot be associated with a specific variable. In order to interpret the impulses, it is common to apply a transformation to the innovations so that they become uncorrelated. The Cholesky transforming method uses the inverse of the Cholesky factor of the residual covariance matrix to orthogonalize the impulses. This method imposes an ordering of the variables in the vector autoregressive and attributes all of the effect of any common component to the variable that comes first in the vector autoregressive system. For stationary vector autoregressive models, the impulse responses should die out to zero and the accumulated responses should be asymptote to some constant.

Figure 4 presents the results of the impulse responses of stock prices to Cholesky one standard deviation innovations of three significant endogenous variables: the Korean stock price (KOSPI) and the Korean won per the Japanese yen exchange rate. The graphs of impulse responses confirm that the stock price dynamics in the Korean stock market are affected largely by their own stock market (KOSPI) dynamics and, to some degree, by the nominal exchange rates of the Korean won per the Japanese yen. The response of KOSPI itself to each shock shows a positive impact in the first few months, then declines and levels off after 24 months. Hence, the impulse response of KOSPI is largely determined by its own shock. In addition, the response of KOSPI to the Japanese yen exchange rate shows a positive impact in the short-run while widening but leveling off after 24 months eventually. One might expect that the nominal exchange rate of the Korean won per the Japanese yen has a positive impact on the Korean stock market prices as the inflow in portfolio investment from Japan increases when the Korean won has depreciated against the Japanese yen.

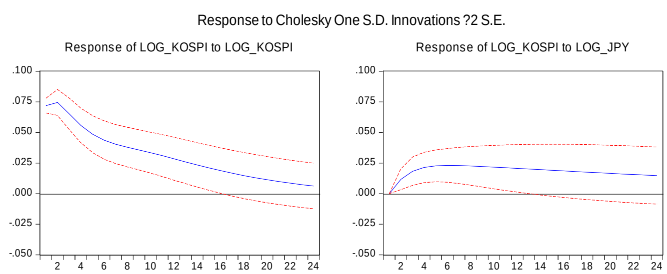

Figure 4: Impulse Response of KOSPI to Innovations of KOSPI and Japanese Yen Variables

6. Discussion

This research contributes to the existing literature in three main aspects. First, this research uncovers the fact that there exists long-run causality from exchange rates to stock prices in the Korean stock market. To be noticed, our results do not say anything about causality from stock prices to exchange rates. This might imply that direction of causality is not considered in this research.

Second, the paper empirically explores short-term causality from exchange rates to stock prices in the Korean stock market. Short-run causality only from the Japanese yen exchange rate to the Korean stock prices is observed. This supports Ogawa and Yang (2008)'s research that the monetary authorities of East Asian countries should care about not only the US dollar and the euro but also the Japanese yen, because Japan has a larger role in intra-regional economic relations.

Finally, the global financial crises of 1997-1998 and 2007-2009 have some impact on the stock price dynamics and the Korean economy. In light of these findings, financial managers can enhance their understanding of the short-run movements of exchange rates and stock price dynamics. A better understanding of these short-run and long-run movements enables financial managers to make well informed investment and financial decisions. While sufficiently understand short-run and long-run movements of exchange rates and stock prices, financial managers and policymakers should as well be aware of that coupling and decoupling effect between specific currencies may exist. This paper suggests that the global financial crises have some impact on the Korean economy, especially on money supply, but it has its limitations in providing much reasoning and convincing points.

Recommendations can be drawn from the findings presented in this paper. From a long-term perspective, policymakers should consider the exchange rates as a policy tool aiming at the Korean stock market since the results of VEC estimates show evidence of the long-run causation from exchange rates such as the Korean won per the U.S. dollar (USD) and the Korean won per the Japanese yen (JPY) to stock prices in the Korean stock market. However, from a short-term perspective, policymakers may consider the exchange rates as a policy tool to manage and control the Korean stock market since the exchange rate of the Korean won per the Japanese yen, to some extent, would cause a positive effect on stock prices in Korea. This policy would be effective in the short-run and should be evaluated soundly.

7. Conclusions

The results of this study acknowledge that: first, there exists long-run causality from exchange rates to stock prices in the Korean stock market. Second, there exists short-run causality from the Japanese yen exchange rate to the Korean stock prices. Third, the global financial crises and/or external shocks have caused instability, to some degree, in the Korean stock market. However, the Korean stock prices are determined largely by their own dynamics in the Korean stock market. It would appear that this inter-dependent behavior of the stock market with exchange rates could be a state of the market liberalization process for its economy to heal and propel itself toward long-run stability and a better future of the Korean stock market. Therefore, policymakers and investors should devote more time and effort acquiring not only the information on changes in monetary policy and temporary external shocks in the short-run but also the knowledge and information about the market itself.

Further research may be directed at some of the above issues. The empirical model may be estimated with alternative economic and financial factors or markets. Studies encompassing different economies should be conducted where data is available. Such research should contribute toward improving our understanding of the market mechanism and responses of each market to the frequently occurring phenomena of economic and financial crisis, whether regional or global.

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