Exchange Market Liberalization, FDI Flows, and Stock Returns in Korea

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Abstract

The purpose of this paper is to analyze the dynamic interactions among foreign direct investment (FDI), stock return, and inflation under two different exchange rate regimes via the VAR model. In December 1997 (during the peak of the Asian financial crisis), South Korea's daily fluctuation limits for the interbank exchange rate were abolished and thus its exchange rate system shifted to a totally free-floating mechanism. We choose monthly data and the sample period is from January 1980 to December 2009. The results show that exchange rate shocks do affect the return rate of the FDI in a shorter duration and the intensity of impact is lower before the foreign exchange market liberalization. After the free floating foreign exchange system was put in effect, the impact of an exchange rate shock on FDI continues for a longer time and at higher intensity. Moreover, after foreign exchange market liberalization, exchange rate shocks can explain the return rate of the FDI much better than before. The same observations apply to the impact of FDI shocks on stock returns. This result shows clearly that currency fluctuations can affect the flow of FDI and this proves that foreign exchange market liberalization (regime dependency) did affect South Korea's financial market quite seriously. Thus, governments, policy makers, and investors should take note that there are many effects when an exchange rate system shifts to a totally free-floating mechanism.

Keywords: Foreign currency market liberalization, Foreign direct investment, Stock returns, Inflation

JEL classification: E31; F31; O24

1. Introduction

South Korea's financial market has drawn the increasing attention of investors after the Asian Financial Crisis of 1997. Indeed, South Korea has achieved high economic growth since the 1970s and has created the much admired "Han River Miracle".[1] South Korea's GDP (Gross Domestic Product) in 1996, before the outbreak of the 1997 Asian Financial Crisis, amounted to US$485 billion, ranking 11th in the world. However, the Asian Financial Crisis makes a big influence on South Korea's financial markets and induced a heavy economic recession and currency depreciation.

In recent years, especially since the end of the 1990s, many countries of AEMs (Asian Emerging Markets) have implemented a series of policy reforms, such as liberalization of their currency markets, which make their exchange rates (EX) more flexible due to the impact of this financial crisis.[2] According to the BoK (The Bank of Korea), South Korea has launched a series of adjustments to its FX policy. By December 16, 1997, South Korea's Government could no longer resist the impacts of this crisis and was compelled to completely change the MARS (Market Average Exchange Rate System) to a free floating FX system.[3]

An investment that involves a long-term relationship between two countries is referred to as foreign direct investment (FDI). FDI, in its classic definition, is defined as a company from one country making a physical investment into building a factory in another country. Such investment does not include foreign investment into the stock

[1] This contributed to the establishment of the steel industry in South Korea and is known as the "Han River Miracle".

[2] Examples are Indonesia and Malaysia.

[3] Under the MARS, the interbank spot rate was allowed to move within an upper limit and a lower limit around each day's basic exchange rate. For the most recent financial turmoil in September 2008, the Bank of Korea has striven actively to respond to the financial and economic turmoil through diverse policy instruments, such as entering into swap arrangements with central banks of major countries, etc.

markets. However, foreign direct investment is thought to be more useful and durable to a country than investments in the equity of its companies because equity investments are potentially "hot money". FDI might produce positive externalities in the form of technology transfers and spillovers on growth. The literature however uncovering effect of exchange rate volatility on FDI is scant and the theoretical predictions are ambiguous. Kosteletou and Liargovas (2000) first document that there are about six competing models, categorized under trade integrated Models and Models of financial behavior, and find that in well-developed countries with freely floating currencies, such as the US, the UK and Japan, causality runs from the real exchange rate to FDI. This result is inconsistent with the predictions of models of financial behavior. Causality runs both ways in small countries with fixed or "quasi'' fixed currencies, such as the EU countries. Cushman (1985) find that that in response to exchange rate risk, multinational firms reduce exports to the foreign country but offsets this by increasing foreign capital input and production.

The reform of an FX system is bound to impact the financial market of any country. As such, the effects of FX system reform in a country on stock returns and foreign direct investment (FDI) is a topic of vital concern. The result of this paper can be a reference for the governments of many countries for their own reforms of their FX systems. This is indeed the main motive of this study. The effects of foreign economic fluctuation on the domestic economy cannot be isolated by a fixed exchange rate system. Furthermore, a floating exchange rate system is also vulnerable to wide fluctuations of the exchange rate.[4] Therefore, the economy of a country cannot be protected against foreign countries' impacts by these two FX regimes. Hence, policy makers and economists are

[4] Svensson (1994) shows that fixed exchange rates are not feasible for achieving price stability.

still seeking the most viable FX system.

As early as in the early 1960s, Fleming (1962) and Mundell (1963) discuss the variations of products under a fixed FX system and a floating FX system. Frenkel and Goldstein (1986) further elaborate that the exchange rate target zone is the hybrid system of fixed and floating exchange rate systems (Krugman, 1991). Werner (1992) indicates that under different economic conditions, the FX policy emerges with different effects on the exchange rate and stock prices. The reform of an FX system then will affect the financial markets.

A free floating FX system forces investors to rearrange their portfolios. Under the free volatility of EX, investors will assume higher risks. Therefore, EX risk is the topic of immediate concern for foreign investors in South Korea's financial markets. In the long and short runs, the fluctuation of EX in South Korea affects FDI and hence the economy of South Korea directly. For inflation rate as exogenous variable, Morelli (2002), Choudhry (2001), and Omran and Pointon (2001) argue that inflation rate has an impact on stock market performance. Sabri (2004) further find that the change in inflation rate is the predicting factor to the volatility of emerging stock markets. Inflation therefore may also result. Therefore, another important motive of this study will be an understanding of the changes of FDI into South Korea under FX reform and the effect of such changes on South Korea's financial markets. According to the release by South Korea, the FX rate system can directly affect the intent of foreign investors.

This paper utilizes a multivariate vector autoregressive model (VAR) approach to focus on the interrelations among four variables under an exchange rate regime when the exchange rate is less flexible compared to the other free floating exchange rate system. We choose South Korea as a case, because of its impressive economic growth and liberalization of financial markets.

Our intent is to provide an empirical background for policy discussions on whether a foreign currency policy should react to asset prices. The research papers most similar to ours in the literature are Edwards (1993) and Tornell and Velasco (1995). They study whether the choice of exchange rate retime affects economic outcomes. This study applies the idea that the choice of exchange rate regime can affect macroeconomic and financial outcomes.

The plan of this article proceeds as follows. Section 2 provides a brief description of the related literature. Section 3 outlines the characteristics of the data and model. Empirical results are presented in Section 4. Finally, Section 5 offers a summary and conclusions.

2. Literature Review

The FX market plays an important role in the economic activity of a country. In the same way, stock prices have always been a good indication of real economic activity. They both are strongly influenced by the volatility of monetary variables. Movement in stock prices may also affect exchange rates and vice versa. Most scholars and investors thus prefer utilizing monetary policies and other economic variables to predict the movements of exchange rates and stock prices.

The interrelations between the FX market and stock market have received considerable attention, mainly for most of the well developed countries. In a pioneer work, Aggarwal (1981) states that the revaluation of the US dollar is positively related to stock market returns. Solnik (1984), however, indicates that there is not quite a significant relationship between the EX and the stock prices. Soenen and Hennigar

(1988) consider a different period, 1980-1986, and show a significantly negative relationship between these two variables.

Following the advancement of the econometrics, other researchers have extended Solnik's basic findings using alternative data and estimation procedures. Bahmani-Oskooee and Sorabian (1992) argue that most previous studies focus on EX affecting stock prices, but overlook the influence of the stock market on the FX market. They find that there is bidirectional causality between stock prices and the effective exchange rate of the dollar, at least in the short run, but there is no long-run relationship between these two variables. Nevertheless, Kwon *et al.* (1997) suggest that South Korea's stock market is more sensitive to EX rather than inflation or interest rate variables (Miller and Reuer, 1998; Doong *et al.*, 2005).

Grier and Grier (2001) argue that any country adopting a fixed exchange rate for stabilization reasons needs to have a well-thought-out exit strategy. The FX policy makers of countries should consider manipulating the FX rate to stabilize the volatility of the stock market. Fang and Miller (2002) and Mishra (2004) point out that there is Granger causality between exchange rate return and stock return (Joseph and Vezos, 2006; El-Masry, 2006). Notwithstanding this, Kanas (2000) states that no evidence is found of volatility spillovers from exchange rate changes to stock returns for some well developed countries via a bivariate EGARCH model.

It is also seen that EX might affect stock prices by way of FDI. Ever since the 1980s, globalization and the integration of economic activity have affected the relationship between FDI and EX. Both FDI and EX movements have become endogenous as a result. Giavazzi and Spaventa (1990) indicate that the large inflows of foreign capital are the major determinants of the EX appreciation observed in some EU countries. Chadee and Crow (1997) suggest that the exchange rate is an effective mechanism through which to influence FDI.

Kosteletou and Liargovas (2000) find that in large countries with freely floating currencies such as the U.S., UK, and Japan, the direction of influence is from EX to FDI. In small European countries, FDI and EX are interdependent. Kerr and Vasanthi (2001) state that the volatility of EX plays an important role on FDI (Nabende, 2002; Tardivo and Dial, 2003; Kiyota and Urata, 2004; Chen, 2005; Ricci, 2006). Only Yang *et al.* (2000) find that EX does not make an impact on FDI in Australia. We may therefore reasonably conclude that whether FDI is affected by EX is due to the different FX regimes of countries.

FDI may directly and indirectly affect stock markets. Wang and Shen (1999) argue that challenges will probably emerge during the process of liberalization, such as increased volatility in stock returns and in the exchange rate. There is also a relationship between monetary policy and the consumer price index (Phylaktis and Kassimatis, 1994). Sabri (2004) argues that when changes in the inflation rate show the least positive correlation to stock price volatility, this represents the least predicting variable.

Although the bulk of the empirical research has studied the relationships between EX - stock price, EX - FDI, and FDI - stock price, it is surprising that little research has been conducted on the interrelations among these three economic variables simultaneously, especially under two different FX regimes. There is one further indicator, inflation (derived from CPI), that we must not ignore. The previous studies even suggest the lack of unequivocal evidence on the relationships among these four variables.

In light of these incomplete studies, a detailed investigation of the interrelation among EX, FDI, stock returns, and inflation under two different FX regimes deserves particular attention. We believe that there has been a great impact on South Korea's financial market from the 1997 Asian financial crisis and its FX system reform.

3. Data and Econometric Model

To explain the dynamic linkages among EX, FDI, stock returns, and inflation, we use the Granger Causality test and Vector Autoregression (VAR) model.[5] The method of analysis allows capturing the short-run dynamics of the variables. The logic behind applying VAR in the presence of the Granger causality test is that in the case of VAR modeling, we do not have any a priori information regarding the endogenity and exogenity of the variables - namely, the estimated specification includes these four variables as endogenity.

3.1 Data Descriptions

In this paper we intend to investigate the dynamic relationships among FDI, stock returns, and inflation under different FX systems in South Korea. The study is based on monthly data spanning from January 1980 to December2009 with a total number of 310 observations. The data relating to stock prices on Korea Composite Stock Price Index (KOSPI) are collected from the database of *Korea Stock Exchange* (KSE), whereas the exchange rate (Won per US dollar), foreign direct investment (FDI), and consumer price index (CPI) data are taken from *Taiwan Economic Journal* (TEJ) database

[5] The VAR comes with a number of tools such as impulse response functions (IRFs) and forecast error variance decompositions (FEVDs), which are not there in Granger causality. In the case of more than a two-variable system, Granger causality may not be robust enough to capture the causality in the presence of VAR.

We define two sub-sample periods in the study, from January 1980 to September 1997 as period I (Market Average Exchange Rate System) and from October 1998 to December 2006 as period II (free floating FX system). In addition, we exclude the period – October 1997 to September 1998, because Korean economy has experienced enormous economic turmoil during crisis period from October 1997 to September 1998 when the first round of financial restructuring was completed following the IMF recommendations, and economic fundamentals do not work together during the crisis period.

This paper constructs a four-variable VAR system. These four variables are the rate of return for exchange rate (REX), the rate of return for FDI (RFDI), the stock returns (SR), and the rate of return for of CPI (inflation).[6] The KOSPI is adopted, because of its high and prevalent trading activity. In addition, the CPI has been the most frequently used variable for measuring an economy's inflation rate (Bernanke and Mihov, 1998; Lubik and Schorfheide, 2004).

3.2 Econometric Model

The order of integration of the variables is initially tested. A test for the presence of a unit root based on the work of the Augmented Dickey-Fuller test (ADF test, Dickey and Fuller, 1979) is used to investigate the degree of integration of the variables used in the empirical analysis. The test is the t statistic on α_1 in the following regression:

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 t + \sum_{i=1}^{p} \beta_j \Delta Y_{t-i} + \varepsilon_t , \qquad (1)$$

[6] We define the rate of return for variables as a logarithm of the ratio of the monthly original data: $V_{i,t} = \log(P_{i,t} / P_{i,t-1}) \times 100$, for $i = EX, FDI, SP, CPI$, where $P_{i,t}$ represents the price or index of the series i at day t, and $P_{i,t-1}$ represents the price or index of the series i at day $t-1$, and $V_{i,t}$ is the rate of return in the data series i.

where Δ is the first-difference operator, ε_t is a stationary random error, Y_t is the series under consideration, and p is large enough to ensure that ε_t is a stationary random error (white noise). The null hypothesis is that Y_t is a non-stationary series, and it is rejected when α_1 is significantly negative. In practice, the appropriate order of the autoregression, p, is not known.

The Johansen maximum likelihood approach (Johansen, 1988) is applied to test for cointegration among the variables. If a long-run relationship does not exist among the four endogenous variables, then the next step involves an estimation of the VAR model. For selecting the appropriate lag length of the VAR model, the suggestion of Engle and Yoo (1987) is followed and the Akaike (1974) information criterion (AIC) is employed. The AIC criterion is defined as:

$$AIC(k) = Min\{\ln(\sigma + 2k/T) | k = 0,1,\ldots,m\}, \qquad (2)$$

where T is the sample size to which the model is fitted, and k is the number of parameters. According to the results, the optimal lag lengths in the VAR model during the whole sample of period, period I, and period II are 6, 3, and 5, respectively.

The VAR model is commonly used for analyzing the short-run dynamic impact of random disturbances on the system of variables. The main objective of estimating VAR in this study is to identify any causal relationship among these four indicators. The forecast error variance decomposition analysis reveals information about the proportion of the movements in sequence due to its “own” shocks versus shocks to other variables. Moreover, the impulse response function traces the effect of a one standard deviation shock to one of the innovations on the current and future values of the endogenous variables. A shock to the *i*th variable directly affects the *i*th variable and is also transmitted to all of the endogenous variables through the dynamic structure of the VAR. We set up a first-order vector autoregression to study the dynamic interaction between the four endogenous variables,

$$x_t = \alpha + \beta x_{t-1} + e_t \, , \tag{3}$$

Where $x_t = (\Delta EX, \Delta FDI, \Delta SP, \Delta CPI)$, Δ represents the first difference operator, α is a 4×1 parameter vector, β is a 4×4 parameter matrix, and e_t is a 4×1 vector of residuals.[7]

4. Empirical Results

The setup of this section is as follows. We first introduce the summary statistics for each sample series and then show the results of ADF unit root tests and the long-run equilibrium relationships via a cointegration test. Third, we employ the VAR model to analyze the short-run impact effects among these macroeconomic variables.

4.1 Descriptive Statistics

Before the time series analysis is applied, the trends of EX (Won against USD), FDI, KOSPI, and CPI are shown in Figure 1.

--- Insert Figure 1 Here ---

In mid-December 1997, which was the high tide of the Asian Financial Crisis, South Korea's government shifted its MARS to a free floating FX regime. As Figure 1(A) shows, the EX starts to fluctuate widely (depreciation substantially) from 1998 onward.

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[7] We attempted to estimate a VAR with other possible orderings as well, but our conclusion does not change.

Figures 1(B) and (C) depict that FDI in South Korea and the KOSPI index seem to be positively correlated with the volatility of EX after the inception of the free floating FX policy in even larger magnitudes, respectively. Figure 1(D) presents that the CPI has also increased substantially in the long run.

It is more noteworthy that after the liberalization of the FX market, the movement trends of FDI and KOSPI become more interrelated. During the period from 1998 to 2000, both the trends of FDI and KOSPI move upward, and then both turn downward after 2000. It seems reasonable to suppose that the correlations between FDI and KOSPI show an increase after South Korea's FX market liberalization. It is also apparent that inflation emerges with a steep rise after South Korea announced the inception of the floating FX system.

Table 1 displays the means, standard deviations, minimum, maximum, skewness, and kurtosis of EX, FDI, KOSPI, and CPI of return rates. During the entire period and for period I, the average returns of FDI are positive. This trend turns to negative after the inception of the free floating FX system. This result provides some preliminary evidence that the new floating FX system substantially decreases the average returns of FDI and also consists of a higher standard deviation during period II. Except for CPI, the standards deviations of all other three variables also increase and the J-B statistics shows that the distributions of the returns series have fat tails and sharper peaks than the normal distribution in period II.

--- Insert Table 1 Here ---

Table 2 shows the correlation matrix of the monthly returns for the four variables in different sample periods. Note that the negative relationship between EX and SP is the highest (-0.2551) and it is followed by the correlation between EX and CPI (0.1574) during the entire period. All variables are negatively correlated with one another except for the correlation between EX and FDI and between EX and CPI. Added to this, the correlation between FDI and CPI tends to increase after the depreciation of the Won against USD.

The F test and Chow test are also applied to examine whether there is a structural change of the EX after shifting to the free floating FX system in order to assure the division of time in this paper.[8] The result indicates that the EX exists with a structural change before and after December 1997 (namely, periods I and II). Table 2 also shows that the volatility of EX is negatively correlated with the stock returns. When the Korean Won depreciated, the KOSPI index also fell. It must be noted, however, that the correlation between FDI and SP during period I has increased apparently as compared with period II as well as has the correlation between EX and FDI. The relationships between these variables tend to improve after the inception of the new FX system, implying that the liberalization and deregulation of the FX market might cause a significant change on the financial market and economy of a country.

--- Insert Table 2 Here ---

4.2 ADF Unit Root Test and Cointegration Test

[8] In order to investigate whether the data provide any evidence of changes in the characteristics of the exchange rate over time, a Chow breakpoint test (1960) is performed. This is achieved by specifying the sample mid-point as a breakpoint date and running an OLS regression on each sub-sample. We then conduct an F-test of the null hypothesis that the coefficients are the same in each sub-period. Specifically, we test the following hypothesis: $H_0 : a_I = a_{II} \; and \; b_I = b_{II}$, $I \neq II$ for sample sub-periods I and II, against the alternative that the parameters are not equal.

Prior to reporting the results, as a beginning this study details the seasonality test as well as the unit root test to examine the time series properties of the concerned variables. In this study, only the ADF Unit Root test of Dickey and Fuller (1981) has been adopted to examine if the data are in stationary series.[9] From Table 3 and Table 4, the ADF statistic suggests that all variables except EX during period I are integrated of order one, I(1). In the case of EX, we reject the null hypothesis of a unit root at its return level.

--- Insert Table 3 Here ---

--- Insert Table 4 Here ---

Table 5 summarizes the results from the Johansen cointegration tests. The two test-statistics give similar results. Both tests provide evidence of not rejecting the null of zero cointegrating vectors at the 10% level. On the basis of the results, the existence of a long-run relationship does not find statistical support in South Korea over these periods under examination.

--- Insert Table 5 Here ---

4.3 Analysis of Interaction in the Short Run (VAR)

The Granger causality test (Granger, 1969) is a simple way to ascertain whether a particular variable is affected by changes in other variables. The test shows whether changes in one variable help forecast one-step ahead returns in another variable. A major advantage of this test is that it is unaffected by the ordering of the VAR system.

[9] As examined in this study, there is no significant difference between the results from the PP and DF unit root tests and the ADF unit root test. Therefore, only the result of the ADF unit root test is stated.

The results of the test are shown in Table 6. Table 6 shows the causality of return between the variables of EX, FDI, KOSPI, and CPI in South Korea. During the entire period and period II, the sequential order is EX, FDI, KOSPI, and CPI. Before the new system, the sequential order is FDI, KOSPI, EX, and CPI.

--- Insert Table 6 Here ---

The precise interpretation of the VAR model is brought to light through the impulse response functions (IRFs) and Forecasting Error Variance Decompositions (FEVDs) to examine the dynamic properties of the system. The results of the IRFs are shown in Figure 2, Figure 3, and Figure 4.

Figures 2(A), (B), (C), and (D) show the impulse response functions indicating the direction of the impact of an innovation in a variable on changes in the other variables during the entire period. From Figure 2(A), it can be seen that an EX shock (one standard deviation shock) has a great impact on itself in the 1^{st} period (month) and such an impact 'dies' out quickly within 2 periods. FDI is significantly affected by an EX shock. EX shocks have a negative impact on FDI in the 3^{rd} period, but the impact turned positive from the 4^{th} to the 6^{th} periods. In the 8^{th} period the impact turned to the negative direction again and then converged to 0 thereafter. The SR has been impacted by EX shocks in the positive direction before the 4^{th} period, and then turned to negative from the 4^{th} to the 9^{th} periods. The EX shocks have less impact on inflation.

Figure 2(B) shows that an FDI shock is significantly affected by its own impact the most during the entire period and is in a negative direction. The effect became less stronger in the 20^{th} period. All other variables responded insignificantly to RFDI.

Figure 2(C) presents that the volatility of SR responds most significantly to its own impact in the short run and such an effect is sustained for about 2 periods. The REX rate responds to the impact of the SR in a negative way, but insignificantly. The RFDI was the most significantly affected by the SR in the positive direction and 'dies' out quickly with 9 periods. This is probably because FDI starts to increase under the bear stock market, and the reverse is true for the bull market. The FDI also has a lagged responses phenomenon. From Figure 2(D), we find that the responses of all variables are insignificant with the exception of the impact of inflation on FDI, which is at a significant and positive level.

--- Insert Figure 2 Here ---

If the entire period is subdivided into two, before and after the inception of the floating FX system, then the result will be different. Figures 3(A), (B), (C), and (D) show the IRFs of the four variables before the inception of the floating FX system. In Figure 3(A), the volatility of EX almost did not respond to its own impact (one standard deviation shock), but responded significantly to FDI the most. The impacts are in the negative direction except in the 3^{rd}, 5^{th} and the 9^{th} periods, which are in the positive direction. Moreover, the significance of the negative impact is higher than the positive impact and this phenomenon continues for about one year.

The impact of the REX on the SR continues much longer and is in the negative direction, implying that the SR increased as the South Korean currency depreciated, and vice versa. The most likely explanation is that South Korea implemented the MARS before the inception of the new FX system. During this period, the SR could only gradually respond to the impact of the REX under the MARS and that led to a prolonged response duration. Inflation is almost unaffected by REX.

Figure 3(B) shows that the RFDI is under the impact from its own innovation more greatly. This result is similar to the result in the entire period. The result in the entire period looked almost the same, which shows that information significantly affected FDI in the positive and negative directions and insignificantly affected other variables. The results displayed in Figures 3(C) and 3(D) are similar to that of Figures 2(C) and 2(D), respectively, and no further explanation will be given here.

Figures 4(A), (B), (C), and (D) show the IRFs of the four variables after the inception of the new floating FX system. The results are different from that before the inception of the new FX system apparently. First of all, the RFDI significantly responds to its own shock and other variables' shocks. The impact duration continues 2 to 3 times longer than that in the entire period and in period I.

Figure 4(A) presents that the SR in response to the REX is in the positive direction from the 1st to the 4th periods, and is in the negative direction from the 5th to the 9th periods, and then it converges to 0. Inflation is not still affected by REX. Figure 4(B) displays that the RFDI caused no impact on inflation. Figures 4(C) and 4(D) only show that the SR and inflation in response to FDI are significant and persistent. It should be concluded, from what has been said above, that this study discovers that the impact of the REX, SR, and inflation on the RFDI turned stronger after South Korea introduced the new floating FX system, and the lagged time is compressed and the effect continues much longer.

--- Insert Figure 3 Here ---

--- Insert Figure 4 Here ---

Forecasting Error Variance Decompositions (FEVDs)

As is known, the FEVDs show the proportion of forecast error variance for each variable that is attributable to its own innovations and to shocks to the other system variables. The transmission of innovations among variables may occur via many channels. This helps to explain the strength of exogenity and the explanation by one another of the variables under fluctuation. For reliability and consistency of the result, the same criterion as used in the IRFs is used for the selection of the sequential order of the variables. The FEVDs (up to 24 months) for each period are presented in Tables 7, 8, and 9.

From Table 7, in the second month 97.577% of the variability in REX is explained by its own innovations, while after one year 88.95% of the variability is explained by its own innovations, 2.775 of the variability is explained by innovations in the FDI shock, 7.2695 in the SP shock, and 1.011 in the CPI shock. The explanatory power given by the SP shock ranked in second place. The explanatory power by the FDI shock also increased. After two years, in the long-run period shocks in EX, FDI, SP, and CPI account respectively for approximately 88.799%, 2.902%, 7.274%, and 1.025% of the variation in the REX. As expected, the explanatory power of the inflation is the weakest in the long run.

For the RFDI variable, own shocks account for almost 99.51% of the forecast variance for the second month. After a year (12 periods), 96.286% of the variation is explained by its own variation, 1.245% by the EX shock, 0.635% by the SP shock, and 1.834% by the CPI shock. In the long run the magnitudes of the explained variability of FDI remain almost the same as in the medium-run period. RFDI is best explained by inflation. In the short run (in the 2nd and 3rd periods), however, the explanatory power of the EX shock is greater than the other two variables, with that of the SP shock the weakest.

In the long run the high SR variability comes from movements in the FDI shocks as well as the EX shocks. A CPI shock, however, provides a better explanatory power to SR variability in the short run. Inflation could be explained by the EX shock, followed by SP and FDI shocks. It seems reasonable to conclude that the EX shock has played the most important role in the entire period and can better explain the other variables, followed by FDI and SR shocks. Inflation reflects the price of final good and is the weakest in explanation.

--- Insert Table 7 Here ---

This paper gives weight to analyze the different dynamic interactions among the four economic variables before and after the new FX regime in South Korea. By dividing the entire period into period I and period II, the results from FEVDs are dissimilar. Table 8 shows the FEVDs of all variables in period I. During this period, with the exception of its own shock, the SP shock can explain REX the highest and it is then followed by the FDI shock. The EX shock can best explain RFDI, followed by the CPI shock.

More noteworthy is that the explanatory power of the EX shock in explaining SR is at approximately 60% during period I. Therefore, it is obvious that under the MARS, SR is significantly affected by the EX shock. This result matches that of the IRFs, indicating a long lasting impact of the EX shock on SR with gradual responses.

Similarly, the explanatory power of FDI on explaining SR also increased. In the same period, the explanatory power of the EX shock in explaining inflation was also greater, followed by SP and FDI shocks. In addition, it is obvious that the SR also does affect the inflation rate.

Table 9 presents the FEVDs in period II. REX is still affected by SP shocks at the most significant level. The explanatory power of inflation is greater than FDI in the long run. In other words, the appreciation (depreciation) of the South Korean currency was affected by its domestic inflation rate. After the liberalization of the FX system, the inflation shock can explain SR the best, and such explanatory power goes up to 14.402% by the 24th period, followed by EX and FDI shocks. The FDI shock can best explain inflation in the long run, but the EX shock can best explain inflation in the short run.

--- Insert Table 8 Here ---

--- Insert Table 9 Here ---

The above findings lead us to know that the four variables emerge with different results of IRFs and FEVDs before and after South Korea's government shifted the MARS to the free floating FX system. In period II, the EX shock could explain the variables better with the exception of SR. Similarly, the EX shock affected RFDI more significantly. This implies that after the inception of the free floating FX system, the EX shock has affected the amount of FDI into South Korea and does affect the SR through the FDI shock apparently. The correlation between the inflation rate and FDI also turns out to be significant.

5. Conclusion

This paper aims at studying the effect of the liberalization of the FX market in South Korea on the dynamic interactions among EX, FDI, KOSPI, and inflation. The sample period covers from January to October 1980. The entire sample period is also subdivided into period I (before the inception of the new FX rate system) and period II (after the inception of the new FX rate system). The empirical findings indicate that there are no long-run equilibrium relationships among EX, FDI, SP, and CPI during our sample periods. The FX market liberalization has affected the interactions among these four variables and also changed their causalities. With the results of the VAR model, EX shocks do affect RFDI in a shorter span and the intensity of impact is low before FX market liberalization. After the free floating FX system was in effect, the impact of the EX shock on FDI continues longer and at a higher intensity.

As shown in the results of FEVDs, the FX market liberalization, EX shocks can explain RFDI much better than before. The same applies to the impact of FDI shocks on SR. This result shows clearly that those currency fluctuations can affect the flow of FDI and proves that the FX market liberalization did affect South Korea's financial market quite seriously. Thus, further liberalization of FDI must fully consider the implications of currency fluctuations and establish rules to monitor currency movements' globally. These results lead to the conclusion that the reforms of the FX system in one country are bound to bring about a great impact upon the macro economy of this country.

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Table 1. Preliminary Statistics of Monthly Return Rates

	REX	**RFDI**	**SR**	**Inflation**
	Entire period: Jan. 1980 - Dec. 2006			
Mean	0.1980	1.1619	0.8109	0.4770
Std. Dev.	3.2659	102.4036	8.5236	0.7167
Minimum	-16.5747	-318.7860	-31.8104	-1.1847
Maximum	37.5992	325.3814	41.0616	4.2402
Skewness	5.0982	-0.0046	0.3608	1.7480
Kurtosis	64.2977	0.8663	2.1660	5.5704
J-B	52094.0088 ***	9.2265 ***	64.0675 ***	531.6308 ***
	Period I: Jan. 1980 – Sept. 1997			
Mean	0.3364	1.6352	0.6515	0.5517
Std. Dev.	1.5970	99.8039	7.1722	0.7494
Minimum	-2.6973	-318.7860	-31.8104	-1.1847
Maximum	18.7214	325.3814	25.5445	4.2402
Skewness	7.6377	-0.1608	-0.0152	1.8147
Kurtosis	85.8042	0.9900	2.2321	5.7335
J-B	65512.9049 ***	9.3453 ***	42.9798 ***	397.1367 ***
	Period II: Oct. 1997 - Dec. 2006			
Mean	-0.5612	-0.2973	1.2921	0.2760
Std. Dev.	3.6686	109.4399	11.1330	0.5563
Minimum	-16.5747	-276.9627	-23.7930	-0.6058
Maximum	9.2720	286.8312	41.0616	2.3481
Skewness	-1.0488	0.2973	0.4894	1.0147
Kurtosis	4.6846	0.6820	0.9309	1.8694
J-B	95.5004 ***	2.9678	6.6148 **	27.5980 ***

Note: REX, RFDI, SR, and Inflation represent the monthly change rate of the exchange rate (Won/USD), foreign direct investment, stock index, and consumer price index, respectively. J-B is the Jarque-Bera normality test, which is distributed, in the null hypothesis of normality, as a χ_2^2. Significance levels of 5% and 1% are represented by ** and ***, respectively.

Table 2. Correlation Matrix of Monthly Return Rates

	REX	RFDI	SR	Inflation
		<u>**Whole sample period**</u>		
REX	---------			
RFDI	0.0341	---------		
SR	-0.2551	-0.0080	---------	
Inflation	0.1574	-0.0432	-0.0123	---------
		<u>**Sub-period I and Sub-period II**</u> (See *Table's note*)		
REX	---------	-0.0160	-0.3120	0.0453
RFDI	0.0778	---------	-0.0009	-0.0149
SR	-0.2801	-0.0153	---------	-0.0335
Inflation	0.0363	-0.1516	0.0821	---------

Note: The upper and lower triangular matrices represent Sub-period I and Sub-period II, respectively.

Table 3. Augment Dickey-Fuller (ADF) Unit Root Tests at Level

	No intercept and trend		Constant only		Intercept with trend	
			Entire period			
EX	(11)	0.2758	(11)	-1.5723	(11)	-2.1293
FDI	(19)	-1.5664	(19)	-2.4368	(19)	-4.2106 ***
SP	(2)	0.3777	(1)	-1.4855	(1)	-2.3120
CPI	(12)	2.9009	(12)	0.8898	(12)	-2.7052
			Period I			
EX	(8)	0.6665	(8)	1.8659	(8)	1.2745
FDI	(13)	1.8866	(17)	0.2581	(17)	-1.4432
SP	(0)	-0.3055	(0)	-1.3550	(0)	-0.2221
CPI	(12)	2.6276	(12)	1.5481	(12)	-2.7258
			Period II			
EX	(0)	-1.7814	(1)	-2.9323 **	(1)	-3.0083
FDI	(6)	-0.5595	(6)	-1.8738	(6)	-1.9870
SP	(2)	0.6331	(2)	-1.1424	(2)	-1.8893
CPI	(4)	5.6192	(5)	2.0323	(5)	-3.3305

Note: 1. ** and *** denote significance at 5% and 1%, respectively. 2. Critical Value refers to Dickey-Fuller (1981). 3. The lag augmentation is on the basis of the AIC optimum lag length selection.

4. $\Delta Y_t = \alpha_0 + \alpha Y_{t-1} + \alpha_2 t + \sum_{i=1}^{p} \beta_j \Delta Y_{t-i} + \varepsilon_t$

Table 4. Augment Dickey-Fuller (ADF) Unit Root Tests at Return Level

	No intercept and trend		Constant only		Intercept with trend	
			Entire period			
EX	(10)	-5.1204 ***	(10)	-5.1722 ***	(10)	-5.1733 ***
FDI	(5)	-12.8801 ***	(5)	-12.9344 ***	(5)	-12.9161 ***
SP	(0)	-15.2586 ***	(0)	-15.3594 ***	(0)	-15.3544 ***
CPI	(11)	-3.7533 ***	(13)	-4.4821 ***	(13)	-4.3659 ***
			Period I			
EX	(0)	0.1361	(0)	-0.1192	(0)	-0.0433
FDI	(5)	-10.6528 ***	(5)	-10.7231 ***	(5)	-10.6959 ***
SP	(3)	-5.3038 ***	(0)	-13.4306 ***	(0)	-13.6916 ***
CPI	(11)	-3.5596 ***	(1)	-8.7283 ***	(1)	-8.8871 ***
			Period II			
EX	(0)	-10.7499 ***	(0)	-10.8795 ***	(0)	-10.8494 ***
FDI	(4)	-8.3341 ***	(4)	-8.2807 ***	(4)	-8.2316 ***
SP	(1)	-6.7987 ***	(1)	-6.8202 ***	(1)	-6.7925 ***
CPI	(10)	-0.7966	(3)	-7.6545 ***	(3)	-8.2658 ***

Note: See Table 3.

Table 5. Results of Johansen Cointegration Test

Eigenvalue	L-max	Trace	$H_0 = r$	L-max90 critical value	Trace90 critical value
			Entire period		
0.1162	14.68	33.96	0	18.03	49.91
0.0580	10.28	21.28	1	14.09	31.88
0.0377	7.10	16.00	2	10.29	17.79
0.0168	4.90	4.90	3	7.50	7.50
			Period I		
0.2501	15.29	32.62	0	18.03	49.91
0.2093	9.38	17.32	1	14.09	31.88
0.0288	6.03	10.95	2	10.29	17.79
0.0236	4.92	4.92	3	7.50	7.50
			Period II		
0.3944	13.12	39.25	0	18.03	49.91
0.2252	11.44	20.12	1	14.09	31.88
0.1441	7.07	15.69	2	10.29	17.79
0.0306	2.61	2.61	3	7.50	7.50

Note: * denotes significance at 10%.

Table 6. Results of Granger Causality Test

Granger causality test states that if a and b are two time series variables and if the past value of a variable a significantly contributes to forecasting the values of another variable b, then a is said to Granger cause b and vice versa. The test involves the following:

$$a_t = \gamma_0 + \sum_{i=1}^{n} \alpha_i b_{t-i} + \sum_{j=1}^{n} \beta_j a_{t-j} + u_{1t}$$ for a, b = EX, FDI, ST, and CPI, $a \neq b$, where t denotes the time period.

$$b_t = \gamma_1 + \sum_{i=1}^{n} \lambda_i a_{t-i} + \sum_{j=1}^{n} \delta_j b_{t-j} + u_{2t}$$

	F-Statistics	P-Value	F-Statistics	P-Value
Hull Hypothesis	RFDI no Granger cause REX		REX no Granger cause RFDI	
Entire period	0.9669	0.4480	0.6971	0.6521
Period I	3.9429	0.0092 ***	0.8241	0.4820
Period II	0.3277	0.8947	1.0641	0.3876
Hull Hypothesis	SR no Granger cause REX		REX no Granger cause SR	
Entire period	2.9743	0.0079 ***	6.1947	0.0000 ***
Period I	4.3306	0.0056 ***	4.2291	0.0063 ***
Period II	1.0887	0.3742	1.4259	0.2255
Hull Hypothesis	Inflation no Granger cause REX		REX no Granger cause Inflation	
Entire period	0.5487	0.7709	4.4372	0.0003 ***
Period I	0.5939	0.6198	1.1199	0.3422
Period II	0.5196	0.7606	2.2762	0.0560 *
Hull Hypothesis	SR no Granger cause RFDI		RFDI no Granger cause SR	
Entire period	0.2128	0.9726	0.4019	0.8776
Period I	0.1340	0.9397	0.7229	0.5394
Period II	0.5419	0.7439	0.6145	0.6891
Hull Hypothesis	Inflation no Granger cause RFDI		RFDI no Granger cause Inflation	
Entire period	0.8310	0.5468 *	0.5052	0.8042
Period I	2.6100	0.0527	0.3006	0.8250
Period II	0.2865	0.9190	0.4578	0.8063
Hull Hypothesis	Inflation no Granger cause SR		SR no Granger cause Inflation	
Entire period	0.6343	0.7028	0.8249	0.5514
Period I	0.3009	0.8247	1.6425	0.1809
Period II	1.5097	0.1977	0.6543	0.6592

Note: *, **, *** denote significance at 10%, 5%, and 1%, respectively.

Table 7. Forecast Error Variance of Decomposition for the Entire Period

Period	EX Shock	FDI Shock	SP Shock	CPI Shock
		Variance decomposition of REX (%)		
1	100.000	0.000	0.000	0.000
2	97.577	0.087	1.881	0.455
3	91.935	0.843	6.739	0.482
6	90.116	1.969	6.983	0.932
12	88.950	2.770	7.269	1.011
18	88.811	2.891	7.275	1.022
24	88.799	2.902	7.274	1.025
		Variance decomposition of RFDI (%)		
1	0.000	100.000	0.000	0.000
2	0.315	99.509	0.112	0.064
3	0.419	99.163	0.150	0.268
6	1.134	96.779	0.572	1.514
12	1.245	96.286	0.635	1.834
18	1.264	96.232	0.638	1.865
24	1.266	96.230	0.638	1.866
		Variance decomposition of SR (%)		
1	0.000	0.000	100.000	0.000
2	4.920	0.128	94.396	0.556
3	8.617	0.163	90.607	0.613
6	11.806	0.775	86.704	0.714
12	13.480	0.985	84.772	0.763
18	13.499	1.007	84.706	0.788
24	13.499	1.010	84.697	0.794
		Variance decomposition of Inflation (%)		
1	0.000	0.000	0.000	100.000
2	5.009	0.003	0.129	94.860
3	11.277	0.046	2.035	86.642
6	10.963	0.704	2.539	85.793
12	11.212	1.115	2.720	84.952
18	11.165	1.184	2.709	84.942
24	11.161	1.194	2.705	84.941

Note: The horizontal sum of each row (explanatory power) is 100.

Table 8. Forecast Error Variance of Decomposition for Period I

Period	EX Shock	FDI Shock	SP Shock	CPI Shock
		Variance decomposition of REX (%)		
1	100.000	0.000	0.000	0.000
2	96.185	0.173	3.447	0.196
3	93.328	1.319	4.854	0.500
6	89.744	1.279	8.446	0.531
12	88.029	1.305	9.955	0.711
18	87.383	1.298	10.516	0.804
24	87.058	1.294	10.794	0.854
		Variance decomposition of RFDI (%)		
1	0.000	100.000	0.000	0.000
2	2.261	97.025	0.252	0.462
3	2.829	95.478	1.243	0.451
6	2.761	92.963	1.318	2.958
12	2.774	92.821	1.326	3.079
18	2.778	92.816	1.327	3.079
24	2.782	92.812	1.328	3.079
		Variance decomposition of SR (%)		
1	0.000	0.000	100.000	0.000
2	5.531	0.027	94.440	0.002
3	15.230	0.028	84.555	0.188
6	33.778	0.881	65.124	0.217
12	48.590	1.005	49.988	0.417
18	55.460	1.052	42.952	0.536
24	59.300	1.080	39.012	0.608
		Variance decomposition of Inflation (%)		
1	0.000	0.000	0.000	100.000
2	1.126	0.076	0.929	97.869
3	10.711	0.273	4.010	85.007
6	19.954	0.539	3.548	75.959
12	34.772	0.647	4.452	60.129
18	43.089	0.744	5.541	50.626
24	47.989	0.804	6.279	44.927

Note: See Table 7.

Table 9. Forecast Error Variance of Decomposition for Period II

Period	EX Shock	FDI Shock	SP Shock	CPI Shock
		Variance decomposition of REX (%)		
1	100.000	0.000	0.000	0.000
2	97.779	0.087	2.100	0.033
3	96.036	0.651	3.183	0.130
6	90.425	1.774	6.314	1.488
12	86.945	2.397	7.082	3.576
18	86.592	2.530	7.176	3.702
24	86.503	2.560	7.182	3.756
		Variance decomposition of RFDI (%)		
1	0.000	100.000	0.000	0.000
2	0.777	98.514	0.642	0.067
3	1.780	97.442	0.683	0.096
6	3.845	90.953	4.108	1.095
12	4.085	89.246	5.051	1.618
18	4.138	88.608	5.174	2.080
24	4.149	88.392	5.187	2.272
		Variance decomposition of SR (%)		
1	0.000	0.000	100.000	0.000
2	5.021	4.761	77.282	12.936
3	10.207	5.953	71.029	12.812
6	10.783	6.171	69.222	13.824
12	11.565	6.420	67.679	14.336
18	11.608	6.577	67.452	14.362
24	11.602	6.623	67.372	14.402
		Variance decomposition of Inflation (%)		
1	0.000	0.000	0.000	100.000
2	5.444	0.755	1.394	92.407
3	5.100	0.809	1.556	92.535
6	5.026	1.030	1.475	92.469
12	5.578	4.327	2.646	87.449
18	5.632	5.844	2.823	85.700
24	5.666	6.373	2.885	85.076

Note: See Table 7.

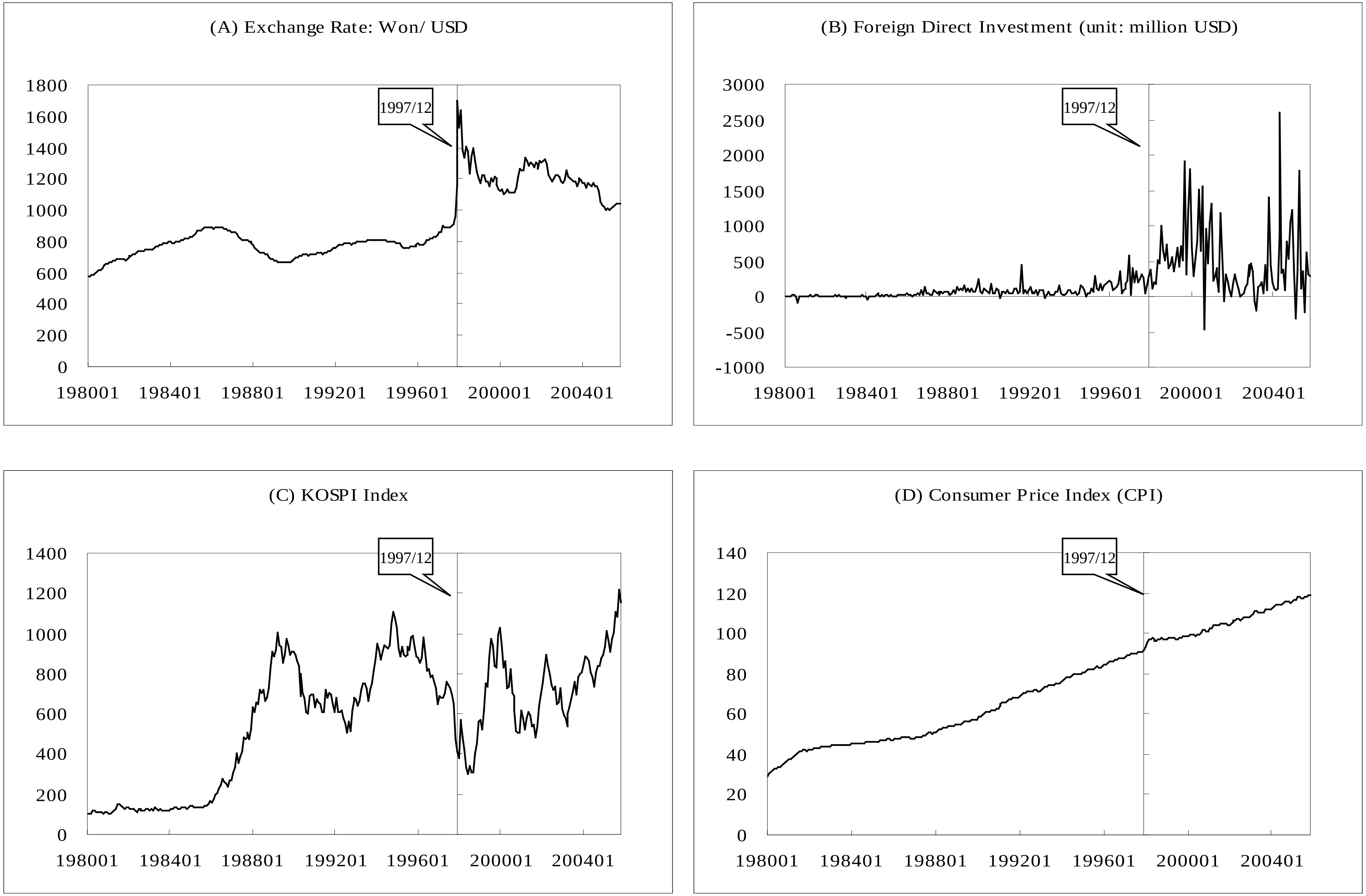

Figure 1. The trends of exchange rate (EX), foreign direct investment (FDI), KOSPI stock index (SP), and consumer price index (CPI)

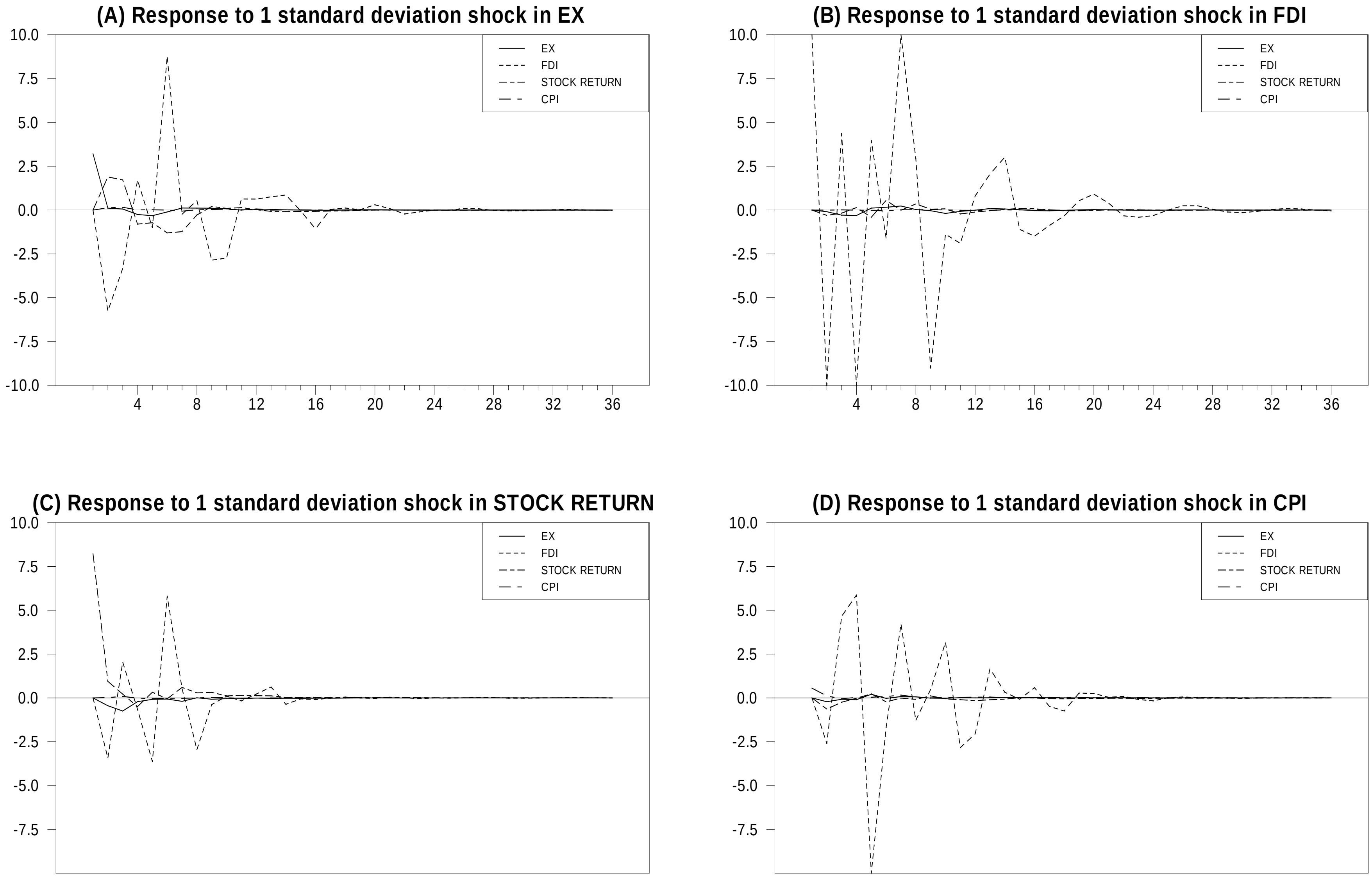

Figure 2. Impulse Response Functions: Entire Period

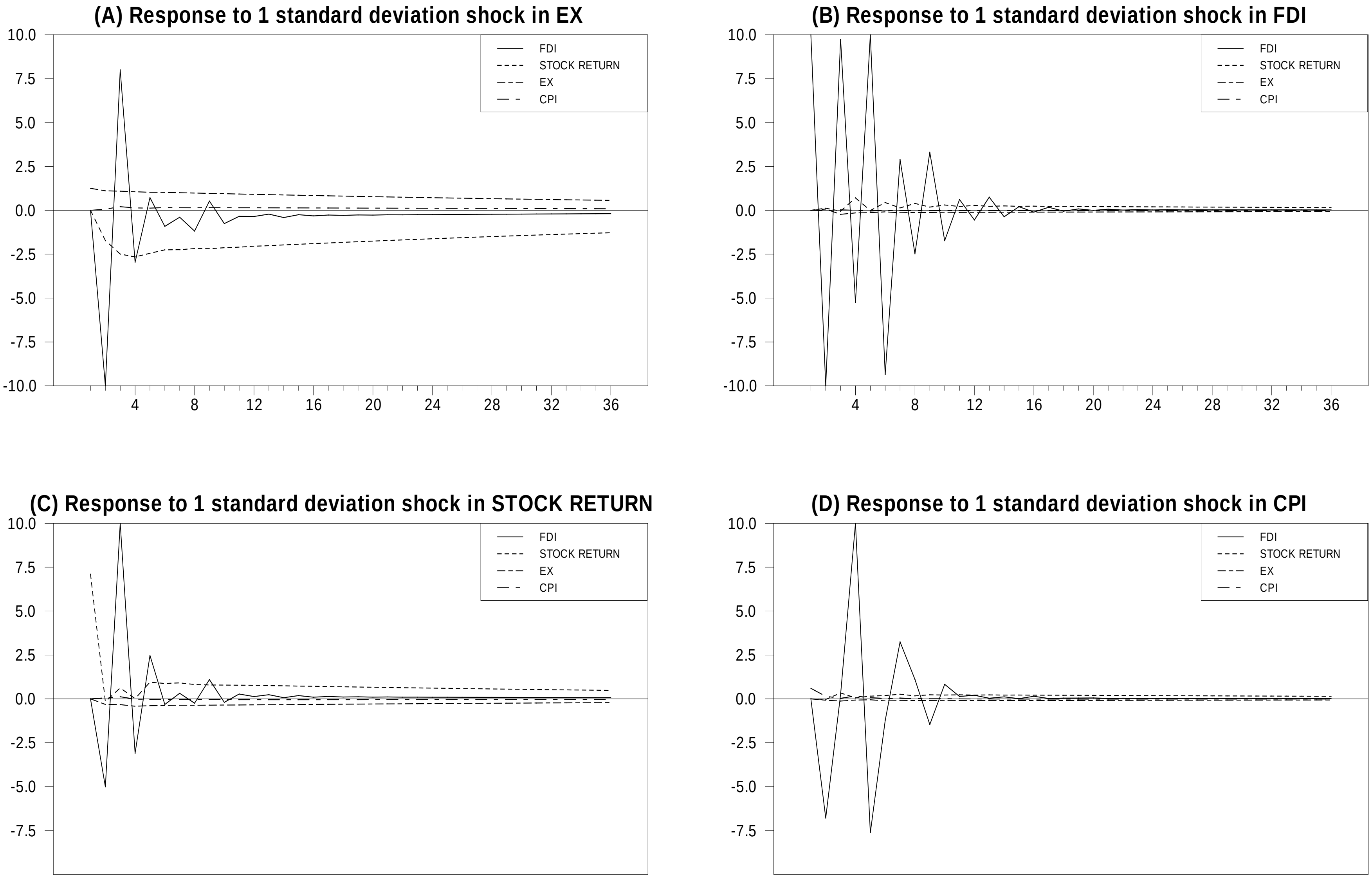

Figure 3. Impulse Response Functions: Period I

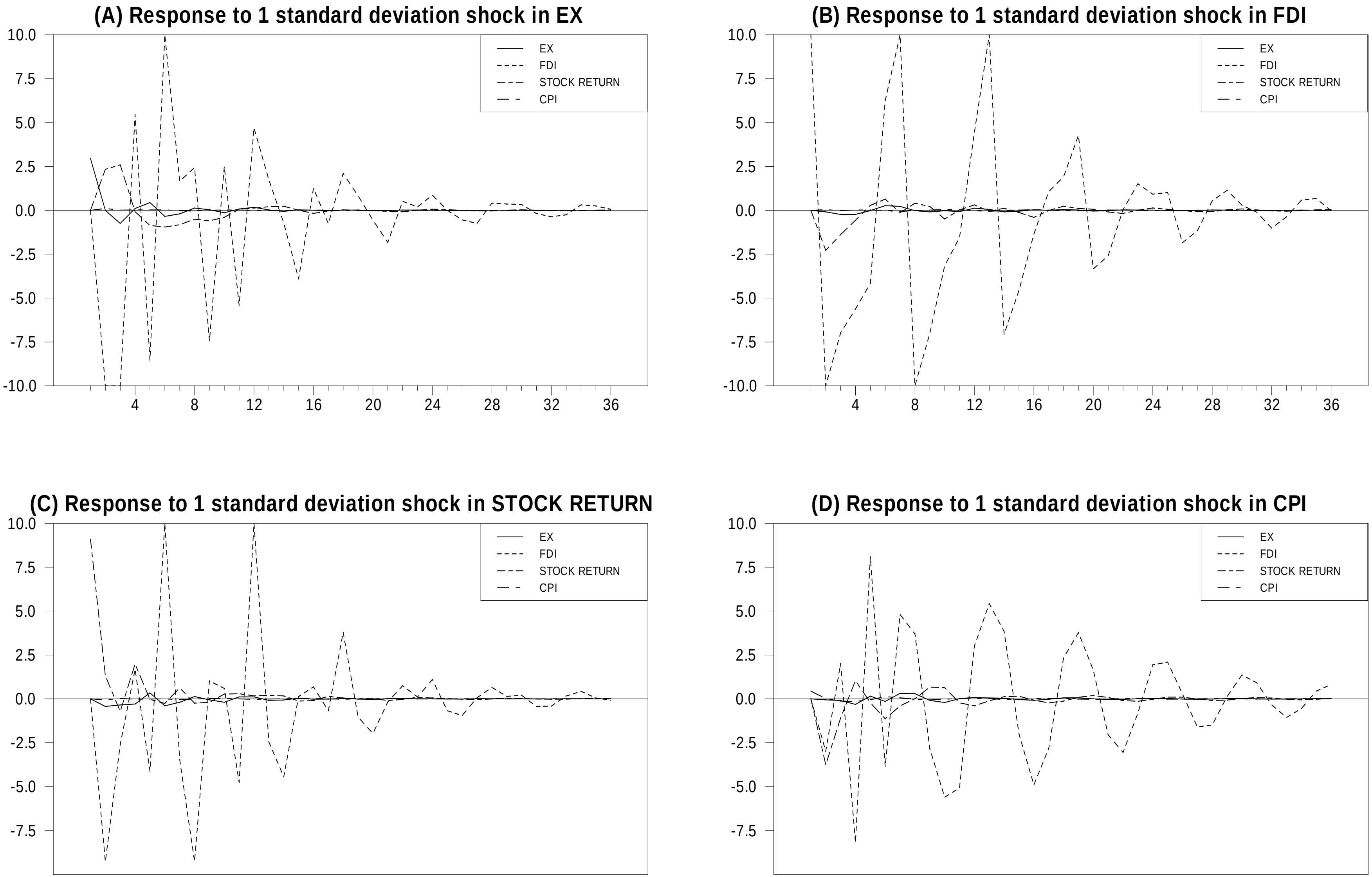

Figure 4. Impulse Response Functions: Period II