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Macroeconomic shocks and stock market returns: the case of Korea

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ABSTRACT
This study examines the effects of macroeconomic shocks on key macro variables, including stock market returns in Korea, using the structural vector autoregression (SVAR) model. We suggest a three-variable SVAR model incorporating inflation, output growth and stock returns. We adopt a nonzero *z*-ratio restriction for the long-run identifying assumption to allow for economically meaningful relationships among variables. While our results support the negative (positive) relation of demand (supply) shocks to stock returns, we also find that demand shocks influence stock market variance more significantly than supply shocks do. The sub-period analysis finds that global market fluctuations during the global financial crisis have relatively little effect on Korean stock market performance. We also examine a generalized five-variable model that includes the foreign exchange rate and interest rate, confirming the results from the three-variable case.

KEYWORDS
Long-run restriction; macro shock; monetary policy; stock market; structural VAR

JEL CLASSIFICATION
C32; E44; E52

I. Introduction

Stock market behaviour can be explained by the dynamic interaction among various macroeconomic variables, such as money supply, price, and real output, and investor reactions to those variables, whose causal relation is reciprocal. These phenomena have been observed in both developed and developing countries (Bernanke and Gertler 2001), including Korea, where financial markets have become increasingly significant. Since the seminal work of Blanchard and Quah (1989) and Clarida and Gali (1994), many researchers have examined the dynamic responses of stock prices to unanticipated shocks using the structural vector autoregression (SVAR) model. Blanchard and Quah (1989) identify the dynamic impact of demand and supply shocks on output and unemployment rate, as in Campbell and Mankiw (1990) and Evans (1989), by imposing structural restrictions based on theoretical assumptions. Their work provides a fundamental framework for imposing long-run restrictions in the SVAR model. Following Blanchard and Quah (1989), Hess and Lee (1999) also examine the effect of macroeconomic shocks on stock returns using long-run identifying restrictions.

The SVAR model allows us to measure the correlation among the variables and examine the impulse responses of the endogenous variables to each shock in a model. Using the forecast error variance decomposition (FEVD), one can estimate the extent to which each variable in the model contributes to explaining the aggregate shocks. Unlike a simple VAR model, the SVAR model can add zero or nonzero restrictions to the long-run relations when identifying and ordering the variables, which gives rise to the economic interpretation. Though several studies, including Keating (1992) and Kilian (2011), point out the drawbacks and limitations of the SVAR model, it remains widely used by many researchers because it allows structural shocks to be correctly identified through long- and short-run restrictions in the economic models.

This article employs the SVAR model to examine the empirical relationship between major macroeconomic shocks and stock market performance in Korea, a leading emerging market. The novel features of this study are that we, first, extend the two-variable model of Hess and Lee (1999) to a three-variable model by including stock market shocks as well as supply and demand shocks. One can view our three-variable model as an extension of Blanchard

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and Quah (1989), who assume that the correlation between gross national product and the unemployment rate can be explained by two types of shocks: (i) those that have a permanent effect on output and (ii) those that have a transitory effect on output. They define the permanent shock as supply shocks and the transitory shock as demand shocks.[1] Using the SVAR model, this study examines the effect of macroeconomic shocks on domestic stock prices by applying the approach of Blanchard and Quah (1989) to Hess and Lee (1999). Our model assumes, following Rapach (2001), that the shock ratio, z, representing a long-run ratio between supply shocks and real stock price responses, is nonzero. In fact, we use a constant shock ratio (z) set to 0.015, indicating that the variability in real stock prices is partly driven by supply shocks.[2]

Second, we generalize the model to a five-variable SVAR following the methods of Sims (1986) and Rapach (2001) by adding two more variables – the interest rate (91-day certificate of deposit [CD91] rate) and the nominal Korean won/US dollar exchange rate – without using a structural model for long-run identification; aggregate spending shock and foreign shock are used as additional shocks in the model.[3] Using the five-variable model allows us to investigate the dynamic interactions between stock prices and macro shocks in greater depth. In particular, we expect the long-run restrictions will allow us to observe both transitional short- and long-term changes (effects) over a course during which the long-run effect has dissipated.

We use monthly Korean stock market and macroeconomic data covering from January 2003 to September 2015. This can be considered a stable period suitable for SVAR analysis because the Korean economy had fully recovered from the Asian financial crisis by 2002. For a robustness check, we divide our sample period into two subsample periods – the crisis (from February 2007 to November 2008) and noncrisis periods – to determine the impact of the global financial crisis (GFC) on stock market returns.[4]

Cumulative impulse response analyses indicate that demand (supply) shocks are negatively (positively) correlated with stock returns in the long run, which is consistent with the results of Blanchard and Quah (1989), Fama (1981), Geske and Roll (1983), Ram and Spencer. (1983), and Rapach (2001). We also find that inflation is positively (negatively) correlated with demand (supply) shocks and that these effects remain significant over time. Variance decomposition results show that demand shocks play a more significant role than do supply shocks in explaining the variability of stock returns, while risk premium shocks explain most of the volatility of stock returns. The sub-period analysis shows that the anticipated market fluctuations during the GFC period have relatively little effect on the Korean market.[5] Unlike in the estimation results from the whole sample period, supply shock and inflation have a positive relationship during the noncrisis period, except for the initial period. The unexpected permanent positive relation between inflation and supply shocks, which reflects the 'price puzzle' (Bernanke and Blinder 1992; Christiano, Eichenbaum, and Evans 1996), reveals that inflation prevails despite an increased supply during the noncrisis period, suggesting that an expansionary monetary policy should be cautiously implemented in accordance with inflation movements.

Moreover, cumulative impulse responses in the five-variable model show that stock returns are negatively (positively) affected by demand (risk premium) shocks in the long run, while the other three shocks – foreign, supply and aggregate spending shocks – do not significantly affect stock returns. Variance decomposition analyses indicate that demand shock and risk premium shock are the two

[1]Though Blanchard, Cerutti, and Summer (2015) argue that demand shocks appear to have permanent effects, given that economies have not recouped from the 2008 global financial crisis (GFC) but have reached their pre-crisis GDP levels, we maintain the assumption that demand shocks do not have permanent effects on output growth or stock market returns, for the following reasons. First, it is difficult to determine whether the outbreak of the GFC is attributable to demand shocks or supply shocks. Second, it is still too early to identify the nature of the shocks that occurred in 2008, especially in Korea, as additional shocks have affected the Korean economy since the GFC.

[2]We would like to thank David Rapach for his comments and suggestions in regard to identifying the z ratio.

[3]We use 'aggregate spending shock' as a proxy for the interest rate shock, assuming that interest rates increase following the increase in aggregate spending.

[4]A series of empirical studies have reported a significant impact of the GFC on emerging markets, including the Korean market. These studies also use a definition of the GFC period that is similar to ours (e.g. Dąbrowski, Śmiech, and Papież 2015; Kim, Kim, and Lee 2015; Kim, Ryu, and Seo 2015; Shim et al. 2015; Song, Ryu, and Webb 2016).

[5]Huang and Guo (2008), who use the structural vector autoregression (SVAR) model, also derive similar results for Japan.

dominant factors, while foreign risk shocks are the least important determinant.

The remainder of the article is organized as follows. Section II presents a literature review. Section III describes the data used in the analysis, and Section IV illustrates the identification process in the SVAR model. Section V reports the estimation results of the three-variable SVAR model and discusses the empirical findings of the sub-period analysis. Section VI presents the empirical results of the extended five-variable SVAR model, and, finally, Section VII concludes the article.

II. Literature review

A number of empirical approaches have been taken to analyse the interaction among stock returns, prices and macroeconomic variables. Rapach (2001) uses the SVAR model based on the natural-rate hypothesis and demonstrates that money supply, aggregate spending, aggregate supply and portfolio shocks have significant effects on real stock prices and that real stock returns are negatively correlated with inflation. This negative correlation between stock returns and inflation can be explained by a well-known hypothesis of Fama (1981). Geske and Roll (1983) support Fama's conclusion by arguing that stock returns tend to reflect real economic activities, where unexpected negative stock returns could signal an increase in expected inflation. Ram and Spencer (1983) suggest a unidirectional causality from inflation to stock returns and provide evidence on the negative correlation between stock returns and inflation.

Bjørnland and Leitemo (2009) investigate the correlation between US monetary policy and S&P500 returns using the SVAR model and find a simultaneous interdependence between monetary policy and stock prices. Their results show that a monetary policy shock that increases the federal funds rate by 100 basis points results in an immediate drop in real stock prices by 7%–9%, while an increase in stock prices of 1% leads to an interest rate increase of around four basis points. Empirical evidence of a negative relationship between prices and stock returns is also found in Christiano et al. (2010), who conclude that inflation tends to stay low during a bull market based on the dynamic stochastic general equilibrium model. Lee (2006); Hong, Khil, and Lee (2013)[6] and Huang and Guo (2008) also confirm the negative relationship between prices and stock returns using Korean and Japanese data. Bernanke and Gertler (2001) similarly address the relationship between monetary policy shock and asset market returns, finding that it is optimal for a central bank with an inflation targeting rule not to respond to stock market shocks. Christiano, Eichenbaum, and Evans (1996) demonstrate that a contractionary monetary policy shock sharply decreases commodity prices while slowly decreasing the GDP price deflator.

Some studies offer different interpretations of those variables' correlation. For example, Campbell and Vuolteenaho (2004) decompose the S&P500's dividend yield with a VAR method and indicate that there is no negative effect of inflation on stock returns and that inflation is, rather, highly correlated with stock market mispricing (i.e. the inflation illusion), supporting Modigliani and Cohn (1979). Hess and Lee (1999) examine the effect of macroeconomic shocks on stock returns using long-run identifying restrictions and find that the stock return–inflation relation can be either positive or negative depending on the determining factor of inflation. Specifically, the negative correlation between stock returns and inflation is due mainly to real output shocks, whereas their positive correlation is caused by demand shocks (monetary shocks). Lee (1992) and Lee (2010) support the empirical findings of Hess and Lee (1999).

Recent studies focusing on the effects of monetary policy on macroeconomic shocks and economic fluctuations (Smerts and Wouters 2003; Smerts and Wouters 2007; Kim 2014) also support the importance of monetary policy and demand shocks in explaining business cycles. Uhlig (2005) raises a different possibility, however, using a VAR model with sign restrictions. He argues that a contractionary monetary policy shock has no definite effects on real GDP, in a new Keynesian–classical synthesis showing the neutrality of monetary policy.

III. Data description

Consumer price index (CPI) is seasonally adjusted as a proxy for price, and industrial production (IP) and

[6]They imply that the negative correlation is particularly strong in recessionary periods using Korean, UK and US data.

Korea Composite Stock Price Index (KOSPI) are seasonally adjusted and converted to real variables for real output and real stock price, respectively. Macroeconomic data are obtained from the Bank of Korea and stock price data are drawn from *Datastream*. Table 1 shows the results of the Johansen (1988) test. The table indicates that neither the maximum eigenvalue nor trace statistics rejects the null hypothesis of no cointegration at the 5% significance level. Therefore, there is no statistical evidence that the level variables have a long-run association in the three-variable SVAR model. The Augmented Dickey–Fuller test does not reject the null hypothesis of a unit root for all level variables including a time trend term. Therefore, to guarantee stationarity, we use the first differences of all variables after taking logs. The likelihood-ratio test of Sims (1980) using the first differenced data shows that five lags (i.e. VAR[5]) is optimal. The Ljung–Box Q statistics shows that none of the VAR(5) equations has serial correlation. After allowing for the lag length adjustment, the final sample data has 147 observations, whereas there were 153 observations initially.

Table 1. Johansen cointegration test.

Hypothesized of CE(s)	Max. eigen statistic	0.05 critical value	*p*-Values	Trace statistic	0.05 critical value	*p*-Values
None	23.204	25.823	0.106	36.071	42.915	0.204
At most 1	10.111	19.387	0.607	12.866	25.872	0.748
At most 2	2.755	12.517	0.904	2.755	12.517	0.904

Johansen (1988) cointegration test is based on the results of the maximum eigenvalue and trace statistics. The statistics indicate that there is no cointegration at the 0.05 critical level in all variables. The intercept and time trend terms are included. We use the MacKinnon, Haug, and Michelis (1999) *p*-values.

In the extended five-variable model, we add two variables: interest rates and foreign exchange (FX) rates. We use the CD91 rate and the nominal Korean won–US dollar exchange rate as proxies. Panel A of Table 2 presents the summary statistics for the five macroeconomic variables used in the model, including mean, median, SD, Jarque–Bera test statistics and the correlation coefficients among the variables. We use the first difference of log FX rates and the first difference of interest rate without log conversion.

The correlation coefficients presented in Panel B of Table 2 show that real output growth is negatively correlated with inflation and foreign exchange rates while positively correlated with interest rates and KOSPI returns. This result is consistent with traditional economic theory in the economic growth literature. On the other hand, the KOSPI spot return has a negative relation with all variables, except for the positive correlation with real output growth at about 0.2.

Figure 1 presents historical plots of the real log levels of the five variables used in this study (left panels) and of first differences in the log of the variables (right panels) over the entire sample period. All level variables exhibit pronounced adjustments during the GFC period except for log price, which shows a constant increase over time regardless of the macroeconomic fluctuations

Table 2. Summary statistics.

	$\Delta\log(IP)$	$\Delta\log(CPI)$	ΔR	$\Delta\log(FX)$	$\Delta\log(KOSPI)$
Panel A: Descriptive statistics					
Mean	0.0006	0.0021	−0.0204	3.06E-05	0.0053
(Std.)	(0.0012)	(0.0002)	(0.0153)	(0.0020)	(0.0038)
Median	0.0009	0.0016	0.0000	−0.0016	0.0119
Maximum	0.0417	0.0090	0.3000	0.1603	0.1454
Minimum	−0.0496	−0.0034	−1.4600	−0.0857	−0.1880
SD	0.0144	0.0023	0.1889	0.0251	0.0473
Skewness	−0.1249	0.3754	−3.8876	1.7367	−0.9078
Kurtosis	3.9847	3.2221	27.481	13.959	5.2186
Jarque–Bera	6.5367	3.8820	4178.500	837.071	52.053
Probability	0.0381	0.1436	0.0000	0.0000	0.0000
Panel B: Correlation coefficients					
$\Delta\log(IP)$	1				
$\Delta\log(CPI)$	−0.1635	1			
ΔR	0.0212	0.2038	1		
$\Delta\log(FX)$	−0.0400	0.0315	0.0694	1	
$\Delta\log(KOSPI)$	0.2010	−0.0619	−0.0907	−0.5621	1

This table shows descriptive statistics of the five macroeconomic variables used in this study from January 2003 to September 2015, including the mean, median, SD (*Std.*), Jarque–Bera test statistics and the correlation coefficient between variables.$\Delta\log(IP)$ is the first difference in the log of real Industrial Production; $\Delta\log(CPI)$ is the first difference in the log of Consumer Price Index; ΔR is the first-differenced interest rate of a 91-day Certificate of Deposit (CD91); $\Delta\log(FX)$ is the first difference in the log of the nominal Korean won–US dollar exchange rate and $\Delta\log(KOSPI)$ is also first difference in the log of real KOSPI returns.

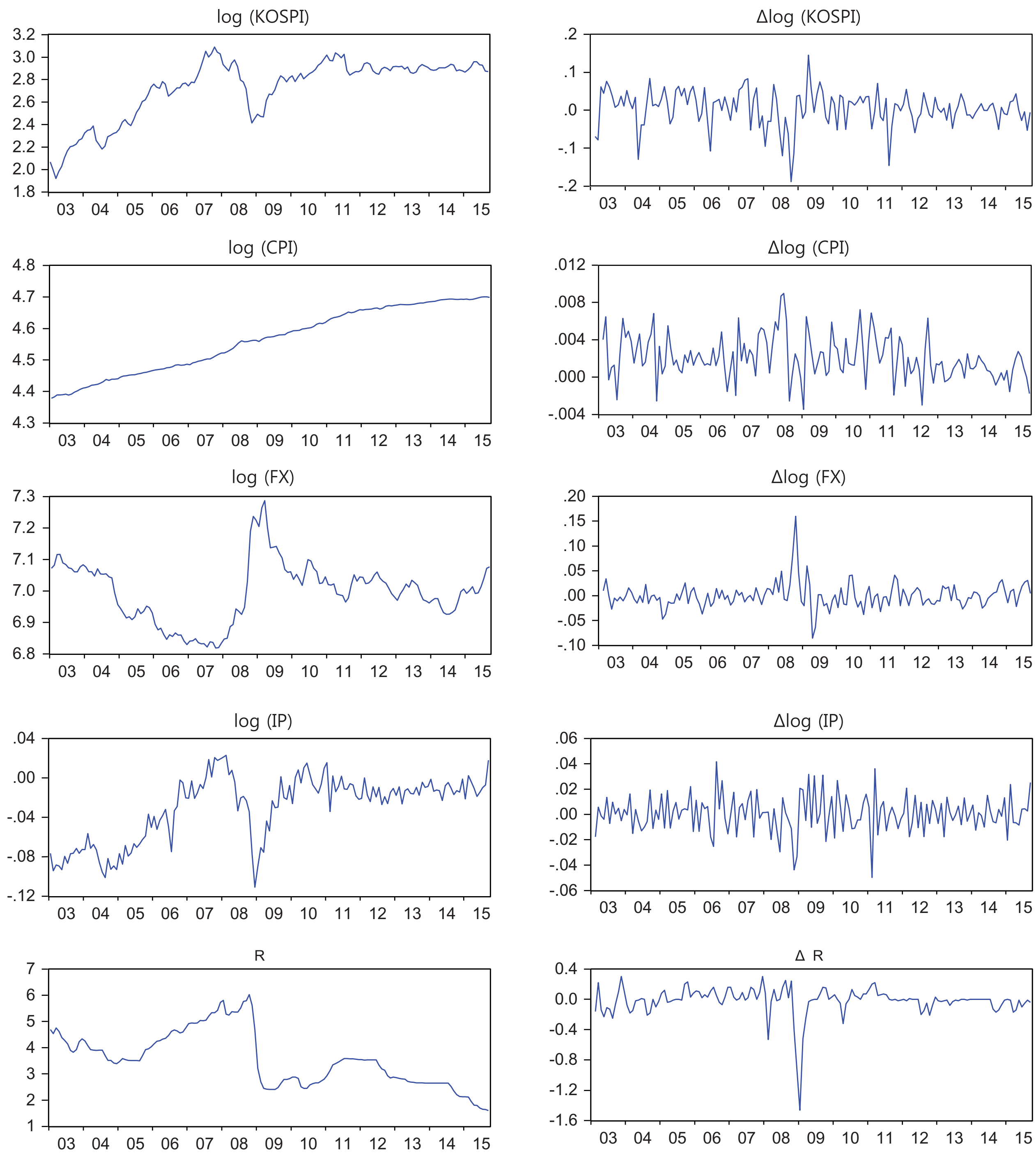

Figure 1. Time-series properties of key macroeconomic variables.

Note: This figure presents historical plots of five types of Korean macroeconomic data from January 2003 to September 2015. The left panels show a level variable in the following order: log of *KOSPI*, log(*CPI*: Consumer Price Index), log(*FX*: Foreign Exchange rate), log(*IP*: Industrial Product) and *R* (91-day Certificate of Deposit rate). The right panels show a firstdifference of these variables: Δlog(*KOSPI*), Δlog(*CPI*), Δlog(*FX*), Δlog(*IP*) and Δ*R*.

during the sample period. This adjustment during the GFC period indicates the presence of structural breaks, where drastic declines are observed in stock prices, real output and interest rates and a surge is observed in the Korean won–US dollar exchange rate.

IV. Identification of the three-variable SVAR model

First, we present a theoretical derivation of the two-variable SVAR model. Then, we apply this theoretical model to a three-variable case that includes inflation, real output growth and real stock returns.

Assuming a bivariate simultaneous equation, the structural VAR can be expressed in matrix form as follows:

$$B_0 X_t = C_0 + B_1 X_{t-1} + \varepsilon t, \tag{1}$$

where $E\left[\varepsilon_t \varepsilon_t^T\right], = d$ and d is a diagonal matrix consisting of σ_1^2 and σ_2^2. Using the lag operator, L, Equation (1) can be written in standard form as follows:

$$\begin{aligned} X_t &= B_0^{-1} C_0 + B_0^{-1} B_1 X_{t-1} + B_0^{-1} \varepsilon_t \\ &= A_0 + A_1 X_{t-1} + U_t, \\ (I - A_1 L) X_t &= A_0 + U_t. \end{aligned} \tag{2}$$

Equation (2) can then be written in terms of its moving average (MA) representation as follows:

$$X_t = \mu + \Psi(L) U_t \tag{3}$$

where $\mu = (I - A_1 L)^{-1} A_0, \Psi(L) = (I - A_1 L)^{-1} = \sum_{k=0}^{\infty} \Psi_k L^k$, $\Psi_0 = I, \Psi_k = A^k, U_t = B_0^{-1} \varepsilon_t$, and $E[U_t U_t^T] = B_0^{-1} E\left[\varepsilon_t \varepsilon_t^T\right] (B_0^{-1})^T = B_0^{-1} d \, (B_0^{-1})^T$. Equation (3) can also be expressed in terms of the structural shocks, as follows:

$$X_t = \mu + \Psi(L) B_0^{-1} \varepsilon_t = \mu + D(L) \varepsilon_t, \tag{4}$$

where $D(L) = \sum_{k=0}^{\infty} D_k L^k = \Psi(L) B_0^{-1}$, ε_t is a structural innovation, D_k matrix represents the dynamic impulse responses of each variable to an individual shock. To calculate $D(L)$, we need only B_0. Let X_t be the vector of variables; then, the long-run restriction can be applied by setting $\lim_{s \to \infty} \left(D_{ij}^s \right) = 0$, where $i, j =$ 1, 2 (i.e. a bivariate model). Thus, the long-run restriction $D(1)$ =0 implies that structural shocks have no long-run effects on the corresponding variables.

Next, we discuss the identification scheme of our model. We apply identifying restrictions in the long-run relations by making the following assumptions. First, price has a long-run effect on neither real output nor on real stock prices (referred to as 'money neutrality'). Second, real stock prices are negatively correlated with inflation. Third, we introduce a shock ratio (z) to apply an additional restriction whereby variability in stock prices is due to changes in GDP in response to supply shocks.[7] Finally, the stock market shock is assumed to be an exogenous shock to demand for stocks, based on the three-asset model of Tobin (1969). For instance, the stock market shock is caused by changes in transaction costs in the stock market or an exogenous change in response to stocks' riskiness level (i.e. risk premium).

Detailed long-run restrictions can be derived from the following simple model, based on typical assumptions made in the macro-money literature.[8] The aggregate demand function can be estimated as follows:

$$Y_t^d = M_t - P_t - i_t, \tag{5}$$

where Y_t^d denotes aggregate demand, a positive function of real money supply (M_t–P_t) and a negative function of interest rate (i_t). The aggregate supply is

$$Y_t^s = N_t + \theta_t, \tag{6}$$

where the aggregated supply (Y_t^s) is a positive function of labour (N_t) and productivity (θ_t). Price and interest rate follow

$$P_t = M_t - i_{t-1} - \theta_t - SP_t, \tag{7}$$

$$i_t = -\alpha M_t, 0 < \alpha < 1, \tag{8}$$

where price (P_t) is positively related with money supply (M_t) and negatively related with interest rate in the prior period (i_{t-1}) and productivity (θ_t), reflecting the Keynesian macroeconomic view of 'sticky price'. The stock price (SP_t) is assumed to have a negative effect on price (P_t). This assumption is necessary for applying identifying restrictions for stock market shocks. Equation (8) describes the interest rate as a negative function of money supply.

We also assume that money supply, productivity, and stock prices follow the random walk process shown below[9]:

[7]In the case of n = 3, the number of restrictions should be larger than three for just identification, which is from $n(n - 1)/2$.

[8]In our three-variable specification, the long-run restriction does not limit contemporaneous response in the variables although the effects become neutral in the long run, as Bjørnland and Leitemo (2009) point out.

[9]We follow Hess and Lee (1999) for the assumption of random walk process.

$$M_t = M_{t-1} + \varepsilon_t^d, \quad (9)$$

$$\theta_t = \theta_{t-1} + \varepsilon_t^s, \quad (10)$$

$$SP_t = SP_{t-1} + \varepsilon_t^b, \quad (11)$$

where the demand shock ($\varepsilon_t{}^d$) stems from money supply shocks, the supply shock ($\varepsilon_t{}^s$) is due mainly to productivity shocks and the risk premium shock ($\varepsilon_t{}^b$) is attributable to stock price shocks. $\varepsilon_t{}^d$, $\varepsilon_t{}^s$ and $\varepsilon_t{}^b$ are serially and mutually uncorrelated. Using these equations and the lag operator L, we can derive identifying restrictions for the model as follows:

(i) The output growth,

$$\begin{aligned}
Y_t^d &= M_t - (M_t - i_{t-1} - \theta_t - SP_t) - i_t \\
&= i_{t-1} + \theta_t + SP_t + \alpha M_t \\
&= \theta_{t-1} + \varepsilon_t^s + SP_{t-1} + \varepsilon_t^b + \alpha(M_t - M_{t-1}) \\
&= \theta_{t-1} + \varepsilon_t^s + SP_{t-1} + \varepsilon_t^b + \alpha\varepsilon_t^d, \\
Y_{t-1}^d &= \theta_{t-2} + \varepsilon_{t-1}^s + SP_{t-2} + \varepsilon_{t-1}^b + \alpha\varepsilon_{t-1}^d, \\
\boldsymbol{Y_t^d} &= \boldsymbol{Y_t^d - Y_{t-1}^d = \varepsilon_t^s + \varepsilon_t^b} + \alpha(\boldsymbol{1 - L})\boldsymbol{\varepsilon_t^d}.
\end{aligned} \quad (12)$$

(ii) The inflation,

$$\begin{aligned}
P_t &= M_t + \alpha M_{t-1} - \theta_t - SP_t, \\
P_{t-1} &= M_{t-1} + \alpha M_{t-2} - \theta_{t-1} - SP_{t-1}, \\
\boldsymbol{P_t - P_{t-1}} &= \boldsymbol{\pi_t = \varepsilon_t^d + \alpha\,\varepsilon_{t-1}^d - \varepsilon_t^s - \varepsilon_t^b} \\
&= \boldsymbol{(1 + \alpha L)\,\varepsilon_t^d - \varepsilon_t^s - \varepsilon_t^b}.
\end{aligned} \quad (13)$$

We define spread as $SP_t - Y_t$, where Y_t is a proxy for aggregate dividends. Then,

$$\begin{aligned}
SP_t - Y_t &= E\left[\sum_{k=0}^{\infty} \rho^k \Delta Y_{t+k}\right] \\
&= \varepsilon_t^s + \alpha(1 - L)\,\varepsilon_t^d + \rho\alpha\varepsilon_t^d + \varepsilon_t^b, \\
&\quad \text{given that } \mathrm{E}[\varepsilon_t] = 0, \mathrm{E}[\varepsilon_{t+k}] = 0 \\
&= \varepsilon_t^s + \alpha(1 + \rho)\,\varepsilon_t^d - \alpha\,\varepsilon_{t-1}^d + \varepsilon_t^b, \\
&\quad 0 < \rho < 1 : \textit{discount factor}
\end{aligned} \quad (14)$$

where E is an expectation operator. Finally, the following equation for stock returns can be derived from Equations (12) and (14):

$$\begin{aligned}
\boldsymbol{\Delta SP_t} &= \boldsymbol{\Delta Y_t + \Delta \mathrm{E}[\sum_{k=0}^{\infty} \rho^k \Delta Y_{t+k}]} \\
&= \boldsymbol{\alpha(1 - L)(2 + \rho - L)\varepsilon_t^d + (2 - L)\varepsilon_t^s} \\
&\quad \boldsymbol{+ (2 - L)\varepsilon_t^b}
\end{aligned} \quad (15)$$

Considering Equations (12), (13) and (15) in the matrix form, then

$$\Delta X_t = \begin{pmatrix} \pi_t \\ \Delta Y_t \\ \Delta SP_t \end{pmatrix} = \begin{pmatrix} D_{11}(L) & D_{12}(L) & D_{13}(L) \\ D_{21}(L) & D_{22}(L) & D_{23}(L) \\ D_{31}(L) & D_{32}(L) & D_{33}(L) \end{pmatrix} \begin{pmatrix} \varepsilon_t^d \\ \varepsilon_t^s \\ \varepsilon_t^b \end{pmatrix}$$
$$= \begin{pmatrix} 1 + \alpha L & -1 & -1 \\ \alpha(1 - L) & 1 & 1 \\ \alpha(1 - L)(2 + \rho - L) & (2 - L) & (2 - L) \end{pmatrix} \begin{pmatrix} \varepsilon_t^d \\ \varepsilon_t^s \\ \varepsilon_t^b \end{pmatrix} \quad (16)$$

The key elements in this matrix for just identification are $D_{21}(L)$, $D_{31}(L)$ and $D_{32}(L)$. These three elements should be zero for just identification. Given that L =1, indicating that the lag length is set to 1, $D_{21}(1) = \sum_{k=0}^{\infty} d_{21}(k)$ and $D_{31}(1) = \sum_{k=0}^{\infty} d_{31}(k)$ become 0. However, $D_{32}(1)$ term becomes 1 instead of 0, which makes just identification impossible. Instead of simply assuming that D_{32} term is 0, which would conflict with the implications of our economic model, we assume that D_{32} is a constant fraction z of D_{22}. That is, changes in stock prices (ΔSP_t) in response to supply shocks can be scaled according to a certain rate of change in GDP (ΔY_t) in response to supply shocks. Given this z restriction, the long-run effects of each macro shock can be expressed as follows:

$$\begin{pmatrix} \pi_t \\ \Delta Y_t \\ \Delta SP_t \end{pmatrix} = \begin{pmatrix} 1 + \alpha & -1 & -1 \\ 0 & 1 & 1 \\ 0 & zD_{22} & 1 \end{pmatrix} \begin{pmatrix} \varepsilon_t^d \\ \varepsilon_t^s \\ \varepsilon_t^b \end{pmatrix} \quad (17)$$

Equation (17) implies that demand shocks have no long-run effects on any of the variables except inflation. We set the shock ratio (z) to 0.015, allowing for a low correlation between supply shocks and stock returns as reported in many empirical studies.[10] The ratio of 0.015 indicates, following the interpretation of Rapach (2001) and Gupta and Roula (2012), that a 10% permanent increase in production leads to a 0.15 percentage point long-run increase in stock prices to meet the market equilibrium. When we set z to 0.015, the

[10]Although the descriptive statistics in Table 2 report a positive correlation between supply shocks and stock returns at about 0.2, prior empirical results such as Pradhan, Arvin, and Ghoshray (2015) reveal that a high output growth rate is not necessarily correlated with high long-run stock returns.

value of D_{32} becomes close to 0, and the just identification is virtually achieved (we also applied 0.25% and 0.05% ratios for the z value, and the different ratios made no significant difference to the result).[11]

V. Estimation results

This section provides empirical test results of the three-variable SVAR model and impulse response along with the FEVD analyses. Table 3 shows that demand shock has a positive effect on inflation and that supply shock and inflation are negatively correlated, while risk premium shock and inflation are positively correlated. All the correlation coefficients are statistically significant. This affirms that our empirical results based on the Korean data do not differ significantly from the literature.

Figure 2 presents the cumulative impulse responses of each macro variable (i.e. inflation, real output growth and real stock returns) to a 1-SD increase in structural shocks. The first column shows that demand shocks initially have a positive effect on inflation. Inflation rises during the first 7 months before diminishing to 0, indicating a permanent increase in the price level and showing that price level has a long-run positive relationship with demand shocks. Meanwhile, demand shocks initially have a positive effect on real output, but their positive effect diminishes and approaches 0 after 10 months. This result implies that demand shock has only a temporary effect on real output, which is consistent with the theory of money neutrality assumed in our model. The last panel in the first column shows a positive effect of demand shocks on stock returns, which is initially quite strong but declines substantially over time, showing a negative relationship. This can be explained by the sticky price phenomenon, whereby prices do not respond immediately to changes in the money supply. This result suggests a negative relation between stock returns and demand shocks. The temporary effect of demand shocks on real stock returns, again, accords well with money neutrality, as evidenced in real output. Overall, the effects of demand shocks are transitory. Real income increases in response to a positive demand shock in the short run, since an expansionary monetary policy such as an interest rate cut can foster domestic investment. However, demand shocks have weak permanent effects on real income because an increase in real income could be cancelled out by a possible long-run increase in the value of the Korean won or a reduced flow of foreign investment into domestic markets. The results also show that a positive demand shock causes stock prices to fall.

The second column of Figure 2 shows that a positive supply shock such as technological innovation causes permanent changes in nominal prices and real output. A long-run negative correlation is found between supply shocks and price levels, which is consistent with traditional economic theory that a positive correlation is observed between supply shocks and real output. A positive supply shock initially has a fairly small negative impact on stock returns, but its effect gradually dissipates over time. The observed initial negative response of stock returns may be attributable to reduced consumer confidence, which could prevail during the GFC included in our sample period. Moreover, the impact of supply shocks on the stock market is relatively modest compared to its impact on inflation and real output. Given a short-run relationship, this result suggests that changes in prices due to monetary policy are a more critical determinant of the stock market reaction than are changes due to supply shocks.

The last column of Figure 2 indicates that a positive risk premium shock has a long-run negative effect on inflation but positive effects on real output growth and

Table 3. Estimated long-run responses in the three-variable SVAR model.

Type of shock		Coefficient	SE	*z*-Statistic	*p*-Value
Demand shock	to Inflation	0.0032	0.0002	17.146	0.0000
Supply shock	to Inflation	−0.0018	0.0003	−6.552	0.0000
	to Output growth	0.0051	0.0003	17.183	0.0000
Risk premium shock	to Inflation	−0.0011	0.0003	−3.686	0.0002
	to Output growth	0.0086	0.0007	13.124	0.0000
	to KOSPI return	0.0601	0.0035	17.146	0.0000

The table shows the estimates of the long-run effects of each shock on the three variables (inflation, real output growth, KOSPI return) in the SVAR model. The results confirm that all the coefficients are statistically significant.

[11]These values are equivalent to 0.000128 and 0.0000256 of D_{22}. The coefficient and the impulse responses from different ratio values produce almost the same results.

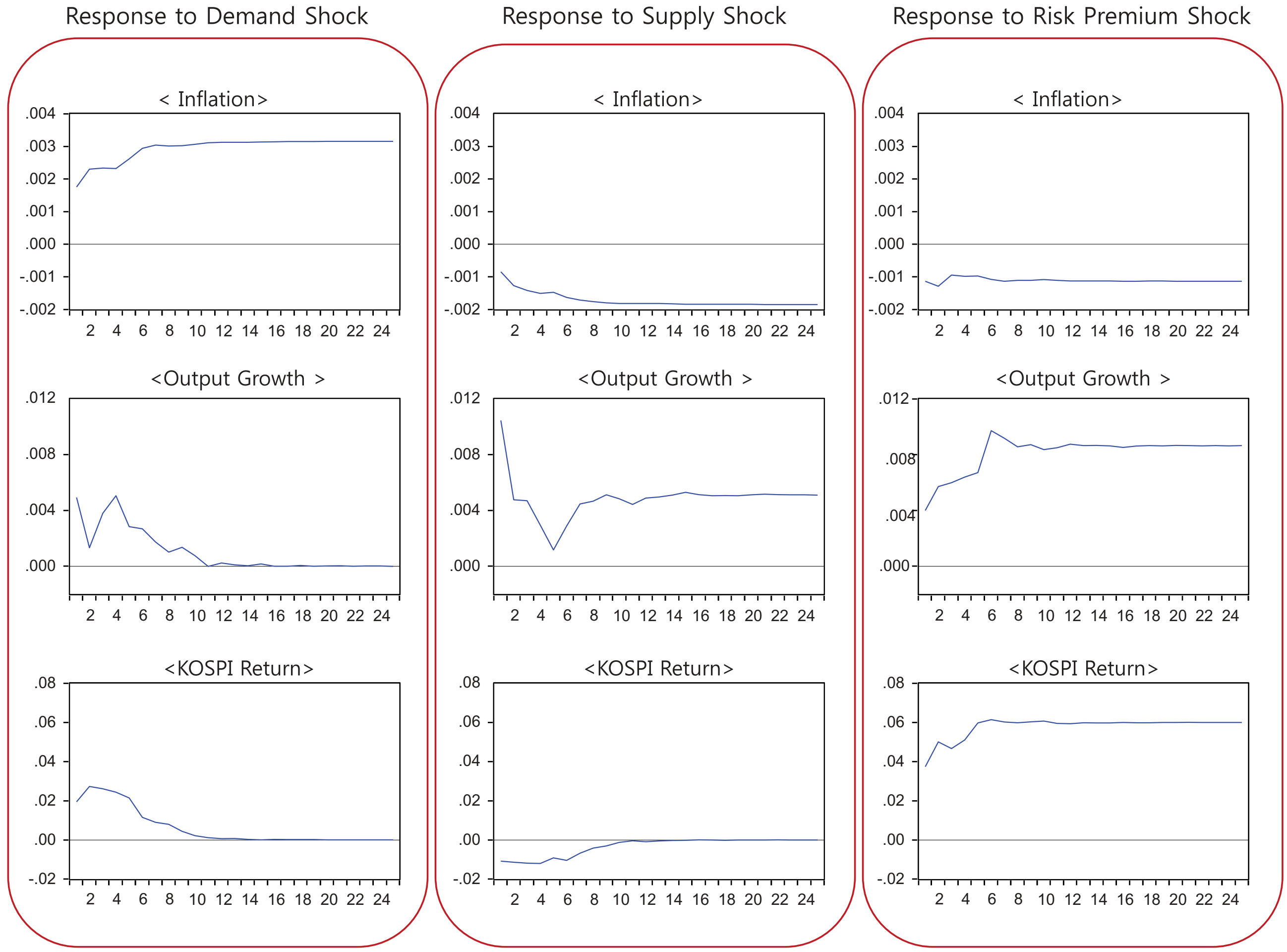

Figure 2. Accumulated impulse responses to structural shocks: whole period.

Note: This figure presents the cumulative impulse responses of each macro variable to structural shocks using monthly Korean macroeconomic data for the entire sample period from January 2003 to September 2015. Note that the impulse responses are calculated up to 25 months after the shock. Each column depicts the impulse responses of inflation, real output growth and real stock returns to a 1-SD increase in each macro shock: the demand shock in the first column, the supply shock in the second column and the risk premium shock in the last column.

stock returns. These observations are all in line with economic intuition.

Figure 3 displays the decomposition of forecast error variance in stock returns derived from demand, supply and risk premium shocks. Risk premium shocks explain most of the variations in stock returns, at nearly 70%. Demand shocks initially account for about 20% of the variance, but their relative importance becomes more significant, up to 25%, at longer horizons. As is evidenced in the weak impulse response of stock returns to supply shocks, supply shocks barely explain the variability in stock returns. These results suggest that demand shocks or monetary shocks such as interest rate changes are more important than supply shocks in explaining variance in stock returns.

Sub-period analysis

The 2007–2008 financial crisis seriously affected the global economy by throwing global stock markets into turmoil and aggravating economic conditions all around the world. The US and major European governments rolled out unprecedentedly long-running counterplans that lowered interest rates to zero and enforced expansionary policies, while many other countries also strived to stabilize their markets by regulating exchange rates. Korea was not an exception, as macroeconomic indices and financial indicators suggested the need for drastic adjustments in their values,[12] and the Korean government endeavoured to stimulate the economy by maintaining interest rates as around 2%. Accordingly, this subsection investigates whether impulse responses for

[12]Refer to the results reported in Figure 1. In addition, Han, Kutan, and Ryu (2015) and Song, Ryu, and Webb (2016) find that Korea's representative implied volatility index, VKOSPI (Volatility Index of KOSPI200), was at its highest at the beginning of the GFC within their research period from 2004 to 2013.

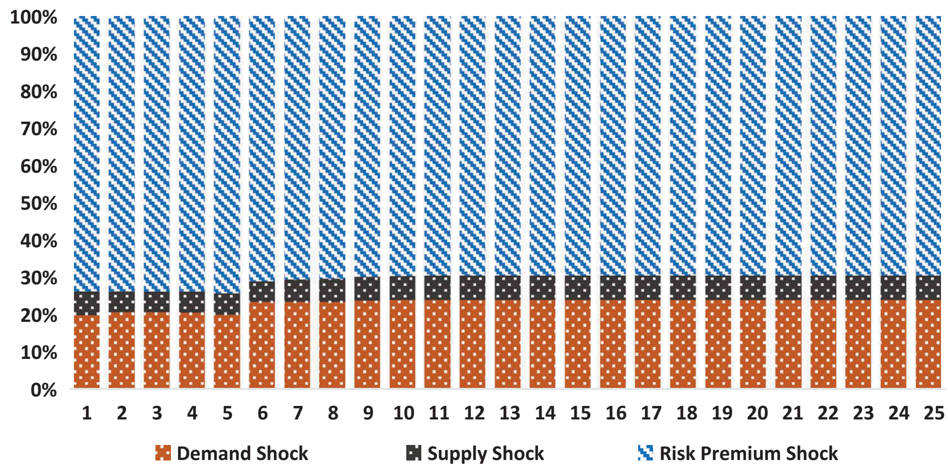

Figure 3. Forecast error variance decomposition of KOSPI stock returns.

Note: This figure presents a decomposition of forecast error variance in KOSPI stock returns resulting from demand shock, supply shock and risk premium shock.

the whole sample period are governed by the GFC period.

We use the Bai and Perron (1998) break point test to determine whether a structural break in stock returns occurs during our estimation period. The results indicate that the highest variances among variables are observed during February 2007 to November 2008, defined as the GFC period.[13] Therefore, we examine a sample period that excludes the GFC period (from February 2007 to November 2008) and compare the results to those for the whole sample shown in Figure 2. The brevity of the GFC period prevents the generation of a meaningful result from it alone. For model estimation, a sequential modified likelihood-ratio test suggests that eight lags are optimal for the noncrisis period case. After allowing for lags, 100 observations remain in the sample.

Figure 4 illustrates that more fluctuations are detected during the noncrisis period for all variables, particularly the responses of inflation, than are reported during the whole sample period (see Figure 2). This observation implies that the anticipated negative impact of the GFC on the Korean economy was relatively modest.[14] Furthermore, a positive supply shock has an initially negative effect on inflation, but this is followed by a positive effect along with a sharp upturn; the positive effect persists in the long run. This is interesting, as it is contrary to the result for the whole sample period, where the response of inflation to supply shocks stays negative at all horizons. The unexpected permanent positive relation between inflation and supply shocks, which reflects the price puzzle (Bernanke and Blinder 1992; Christiano, Eichenbaum, and Evans 1996), reveals that inflation prevailed despite an increased supply during the noncrisis period, suggesting that an expansionary monetary policy should be cautiously implemented in accordance with inflation movements.

The impulse responses of stock returns to each macro shock are presented at the bottom of each column. Demand shocks initially have little effect on stock returns. This is followed by a moderately positive effect at intermediate horizons, but their effect becomes insignificant at longer horizons. Likewise, supply shocks initially have a negative effect on stock returns, followed by a moderately positive effect at intermediate horizons; the effect then approaches zero at longer horizons. Nevertheless, compared to the effects of supply shock on stock returns reported in Figure 2, supply shocks seem to produce more dynamic effects during the noncrisis period. Comparing the impact of risk premium shock on stock returns with that on real output growth, it appears that investment, which is driven by low interest rates, tends to flow into financial assets rather than real assets, reflecting market participants'

[13]The test is estimated using a HAC (Newey–West test) SE and covariance matrix. Break points were observed in periods other than the GFC period, but the GFC period exhibits the highest volatility among macro variables; thus, we chose this period as a reference point for subsampling.

[14]Vieito, Wong, and Zhu (2016) also study the impact of the GFC on G7 stock markets, finding that most of their indices are less volatile.

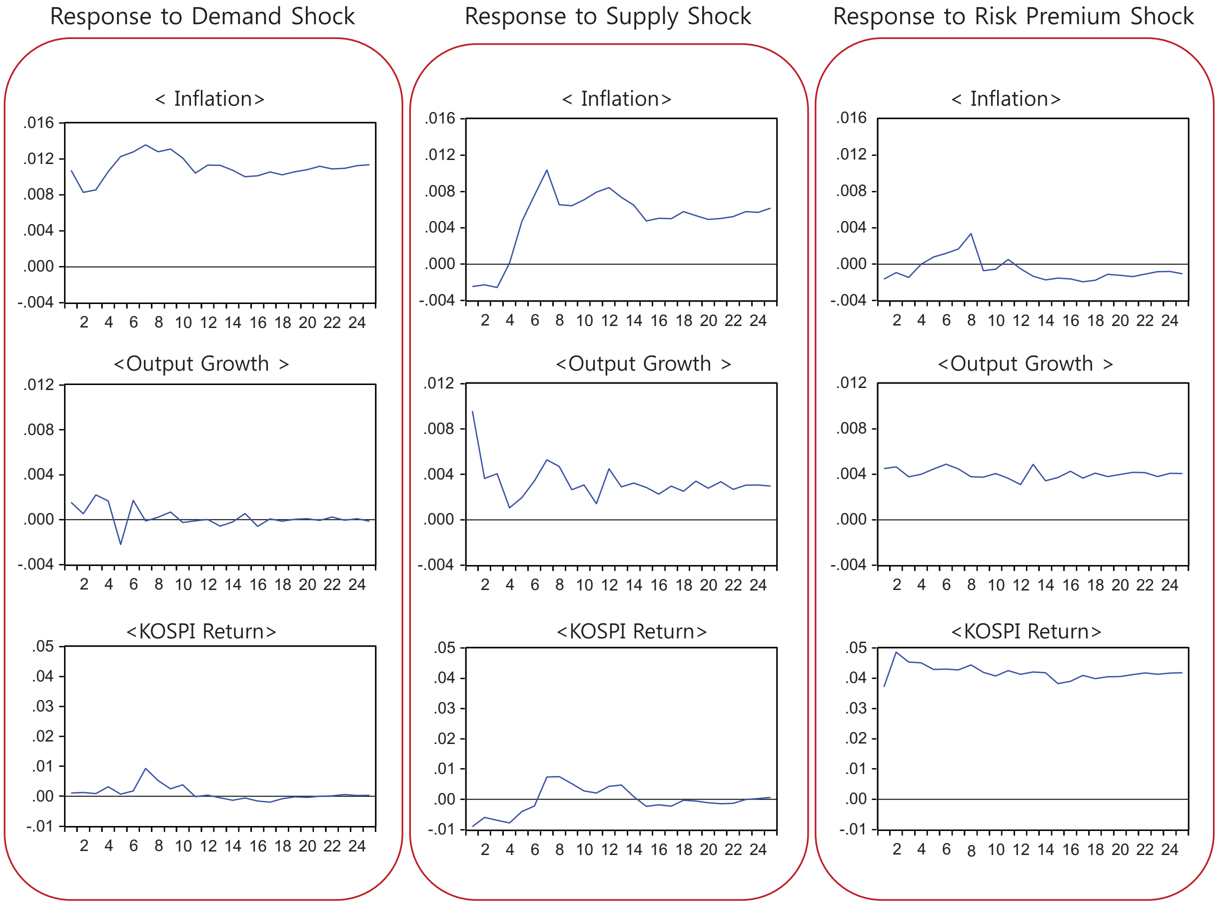

Figure 4. Accumulated impulse response to structural shocks: noncrisis period.

Note: This figure presents the cumulative impulse responses of each macro variable to structural shocks using data observed during the noncrisis period (the sample period excluding the GFC period [February 2007 to November 2008]). Note that the impulse responses are calculated up to 25 months after the shock. Each column depicts the impulse responses of inflation, real output growth and real stock returns to a 1-SD increase in each macro shock: the demand shock in the first column, the supply shock in the second column and the risk premium shock in the last column.

preference for risky assets. The last column also shows that there is a long-run negative relation between risk premium shock and inflation, although the result is not significant,[15] and that stock market shock has considerably positive effects on output and stock returns.

VI. Five-variable SVAR model

This section introduces a generalized five-variable SVAR model and analyses the effects of more diverse macro shocks on the Korean stock market. In addition to the original variables – inflation, output growth and stock returns – used in the three-variable model, we add foreign exchange rate and interest rate in the five-variable model. The first difference in the log of the nominal Korean won–US dollar exchange rate and the first difference of the CD91 rate are used as the proxies for foreign exchange rate and interest rate, respectively. Two additional shocks are added in the model – foreign shock and aggregate spending shock – in addition to demand, supply and stock market shocks. The five-variable model is estimated for the same data period from January 2003 to September 2015. After allowing for an optimal lag of 7 based on the likelihood-ratio test, there are 145 observations in the sample.

We impose the long-run identifying restrictions based on the Granger Causality test results in Table 4. The results indicate that causality flows from stock returns and inflation to the other three variables – real output, FX rate and interest rate. In addition, output growth affects the interest rate.

[15]The SVAR results show that the risk premium shock and inflation are negatively correlated, though the result is insignificant. Since this sub-period analysis focuses on comparing impulse responses to those from the full sample period, we do not report the estimated SVAR coefficients for the sake of brevity.

Table 4. Summary results of the Granger Causality test.

Pairwise Granger Causality tests			
Null hypothesis	Obs.	*F*-statistic	Prob.
Δlog(*CPI*) does not Granger Cause Δlog(*IP*)	145	3.446	0.0020
Δlog(*IP*) does not Granger Cause Δlog(*CPI*)		0.912	0.4991
Δ*R* does not Granger Cause Δlog(*IP*)	145	1.831	0.0864
Δlog(*IP*) does not Granger Cause Δ*R*		3.566	0.0015
Δlog(*FX*) does not Granger Cause Δlog(*IP*)	145	5.349	2.E-05
Δlog(*IP*) does not Granger Cause Δlog(*FX*)		0.681	0.6881
Δlog(*KOSPI*) does not Granger Cause Δlog(*IP*)	145	4.122	0.0004
Δlog(*IP*) does not Granger Cause Δlog(*KOSPI*)		1.402	0.2098
Δ*R* does not Granger Cause Δlog(*CPI*)	145	0.975	0.4523
Δlog(*CPI*) does not Granger Cause Δ*R*		1.366	0.2251
Δlog(*FX*) does not Granger Cause Δlog(*CPI*)	145	0.815	0.5765
Δlog(*CPI*) does not Granger Cause Δlog(*FX*)		2.315	0.0294
Δlog(*KOSPI*) does not Granger Cause Δlog(*CPI*)	145	1.424	0.2010
Δlog(*CPI*) does not Granger Cause Δ*log*(*KOSPI*)		1.384	0.2173
Δlog(*FX*) does not Granger Cause Δ*R*	145	6.198	3.E-06
Δ*R* does not Granger Cause Δlog(*FX*)		1.403	0.2095
Δlog(*KOSPI*) does not Granger Cause Δ*R*	145	7.444	2.E-07
Δ*R* does not Granger Cause Δlog(*KOSPI*)		1.412	0.2058
Δlog(*KOSPI*) does not Granger Cause Δlog(*FX*)	145	5.773	8.E-06
Δlog(*FX*) does not Granger Cause Δlog(*KOSPI*)		0.743	0.6361

Summary of Granger Causality test		
ΔR	←	$\Delta Y, \Delta FX, \Delta SP$
ΔY	←	$\Delta FX, \Delta SP, \pi$
ΔFX	←	$\Delta SP, \pi$
ΔSP	←	–
π	←	–

Test results are based on the first differenced data. The summarized results are attached at the bottom of the table. Δlog(*IP*) is the first difference in the log of real Industrial Production; Δlog(*CPI*) is the first difference in the log of Consumer Price Index; Δ*R* is the first-differenced interest rate of a 91-day Certificate of Deposit; Δlog(*FX*) is the first difference in the log of nominal Korean won–US dollar exchange rate; and Δlog(*KOSPI*) is the first difference in the log of real KOSPI returns.

Thus, the variables are sequenced in the following order: stock return, inflation, nominal exchange return, real output growth and interest rate return. Thus, the vector of variables used in the regression is $\Delta X_t = (\Delta SP, \pi, \Delta FX, \Delta Y, \Delta R)^T$.Arranging these 5 variables and 10 long-run restrictions in the *D* matrix of long-run multipliers described in Section VI, we can derive the following form[16]:

$$\lim_{s\to\infty}\begin{pmatrix}\Delta SP_{t+s}\\ \pi_{t+s}\\ \Delta FX_{t+s}\\ \Delta Y_{t+s}\\ \Delta R_{t+s}\end{pmatrix} = D\varepsilon_t = \begin{pmatrix} d_{11} & 0 & 0 & 0 & 0\\ d_{21} & d_{22} & 0 & 0 & 0\\ d_{31} & d_{32} & d_{33} & 0 & 0\\ d_{41} & d_{42} & d_{43} & d_{44} & 0\\ d_{51} & d_{52} & d_{53} & d_{54} & d_{55}\end{pmatrix}\begin{pmatrix}\varepsilon_t^b\\ \varepsilon_t^d\\ \varepsilon_t^f\\ \varepsilon_t^s\\ \varepsilon_t^r\end{pmatrix} \tag{18}$$

where ε_t^b, ε_t^d, ε_t^f ε_t^s and ε_t^r stand for risk premium shock, demand shock, foreign risk, supply shock and aggregate spending shock, respectively.

To identify the five structural shocks, the following long-run restrictions are imposed. First, the four long-run restrictions in the first line assume that $d_{12} = d_{13} = d_{14} = d_{15} = 0$, indicating that demand shock, foreign risk, supply shock and aggregate spending shock have no long-run effect on stock returns. Stock returns are affected only by risk premium shock in the long run. Second, the assumption that $d_{23} = d_{24} = d_{25} = 0$ indicates that only risk premium and demand shocks have an effect on inflation in the long run. Third, the assumption that $d_{34} = d_{35} = 0$ implies that supply and aggregate spending shocks do not affect the foreign exchange rate in the long run; that is, supply and aggregate spending shocks have an initially temporary effect but no long-run effect on exchange rate fluctuations. Finally, the assumption of $d_{45} = 0$ indicates that the effect of aggregate spending on output growth is negligible in the long run. To recapitulate, our restrictions identify that risk-premium shocks have long-run effects on all variables and that demand shocks affect all variables but stock returns. Foreign shock affects the foreign exchange rate, output growth and interest rate and is affected by risk premium and demand shocks. The supply shock affects only output growth and interest rate but is affected by risk premium, demand and foreign and supply disturbances. Finally, it is identified that all macro shocks have a long-run effect on interest rate changes.

Table 5 depicts the results of the five-variable SVAR model. The impact of risk premium shock on macro variables is illustrated in the first line, supporting the negative correlation between risk premium shock and inflation. It also shows that stock market shock has a negative influence on the foreign exchange rate, while stock market shock shows a positive correlation with stock return, real

[16]See Sims (1986), Bernanke (1986) and Rapach (2001) for models that impose a restriction allowing for simultaneity assuming a lower triangular matrix as well.

Table 5. Estimated long-run responses in the five-variable SVAR model.

Type of shock		Coefficient	SE	*z*-Statistic	*p*-Value
Risk premium shock	to KOSPI Return	0.0385	0.0023	17.029	0.0000
	to Inflation	−0.0013	0.0004	−3.3276	0.0009
	to FX rate	−0.0235	0.0025	−9.4416	0.0000
	to Output growth	0.0063	0.0006	10.131	0.0000
	to Interest rate	0.1851	0.0209	8.8549	0.0000
Demand shock	to Inflation	0.0047	0.0003	17.029	0.0000
	to FX rate	0.0117	0.0020	5.9749	0.0000
	to output growth	−0.0031	0.0005	−6.5963	0.0000
	to Interest rate	−0.0220	0.0178	−1.2318	0.2180
Foreign shock	to FX rate	0.0221	0.0012	17.029	0.0000
	to output growth	−0.0013	0.0004	−3.0001	0.0027
	to Interest rate	−0.0866	0.0170	−5.0902	0.0000
Supply shock	to output growth	0.0050	0.0003	17.029	0.0000
	to Interest rate	0.0071	0.0162	0.4363	0.6626
Aggregate spending shock	to Interest rate	0.1954	0.0115	17.029	0.0000

This table shows the estimates of the long-run effects of each shock on the five variables (KOSPI return, inflation, FX rate, real output growth, interest rate) in the SVAR model from January 2003 to September 2015. The estimation results prove the statistical significance of the SVAR coefficients.

growth and interest rate. The second line illustrates the effects of demand shock followed by foreign, supply and aggregate spending shocks. Demand shock correlates with real output growth and the interest rate negatively, though the effect on interest rate is not significant. Foreign shock displays all negative impacts, except for the exchange rate. The last two shocks – supply and aggregate spending shocks – show positive correlations with real growth and the interest rate respectively, but the positive relation between supply shock and the interest rate is not significant.

Figure 5 presents the cumulative impulse responses of each macro variable (i.e. stock returns, inflation, foreign exchange rate, real output growth and interest rate) to a 1-SD increase in structural shocks. The first line shows the response of our key variable, stock returns, to each shock. Stock returns are positively affected by risk premium shock throughout the whole horizon of 25 months. In addition, stock returns positively respond to demand shock during the first 10 months, but the initial response rapidly decreases to 0 in the long run. The other three shocks – foreign shock, supply shock and aggregate spending shock – do not affect stock returns significantly.

The first column illustrates the cumulative impulse responses to risk premium shocks. Inflation and foreign exchange rate negatively respond to risk premium shock, while output responds positively and strongly to risk premium shock. These results correspond to economic theories and empirical research positing a negative correlation between inflation and the stock market. The interest rate shows a positive accumulated response to risk premium shock only in the long run, with an insignificant response in the short run.

The second column depicts the cumulative impulse response of the macro variables to demand shocks, represented by money supply shocks. A positive demand shock initially affects stock returns positively, suggesting that capital flows into financial markets under lowered interest rates, but this effect becomes neutral over the long horizon. Inflation positively responds to demand shock over the whole horizon, possibly through an increase in investment. The foreign exchange rate negatively responds to demand shocks in the short run, but the effect becomes positive in the mid-to-long term, indicating that a positive demand shock depreciates the Korean won–US dollar exchange rate in the long run. A positive demand shock increases real GDP growth in the short run, but the chain effect of rising inflation or Korean won depreciation helps reduce real output growth in the long run. The long-run negative correlation between demand shock and real output growth suggests that an appropriate growth policy would require the implementation of a more elaborated and longer-term scheme.

The impulse responses to foreign shock (increase in the won–US dollar exchange rate or depreciation of Korean won) are illustrated in the third column. Stock returns do not significantly respond to exchange rate shock. Inflation's response to exchange rate shock is slightly negative in the short

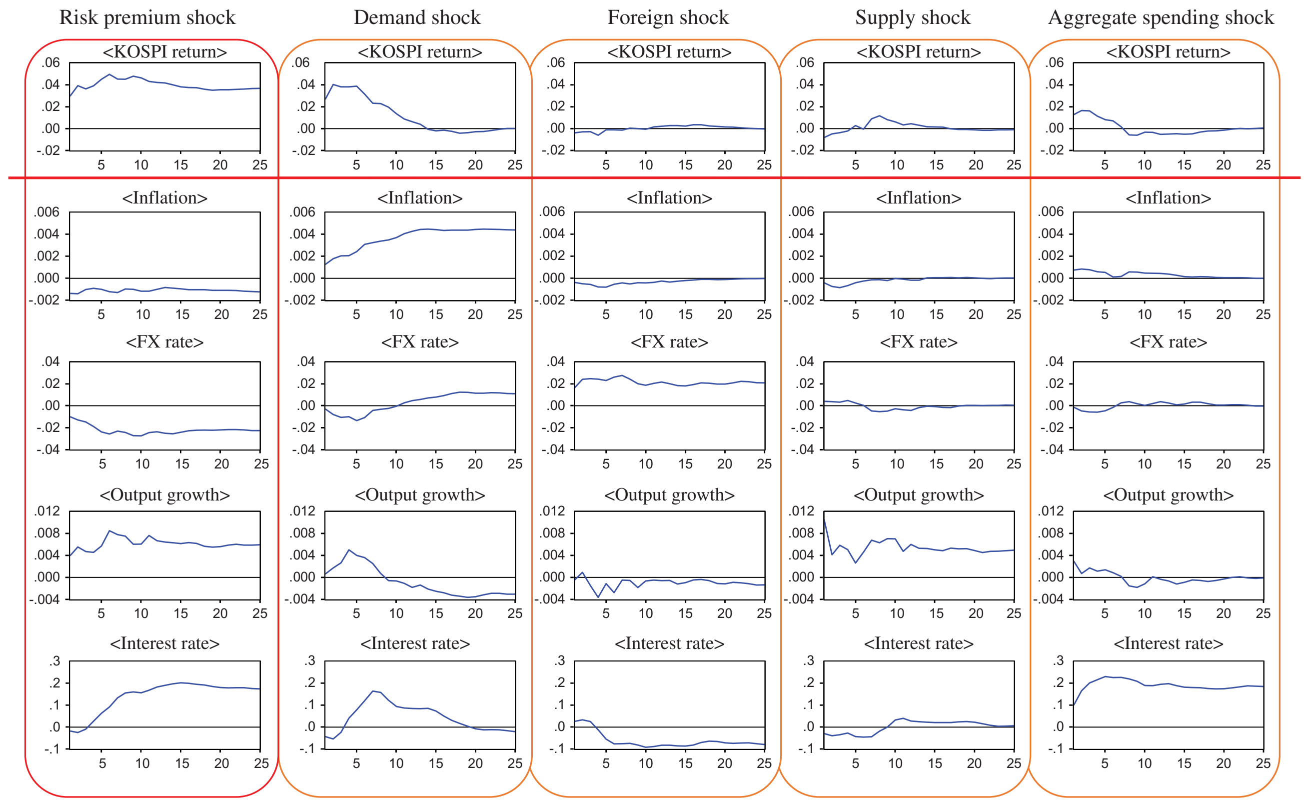

Figure 5. Accumulated impulse response to structural shocks: five-variable model.

Note: This figure presents the cumulative impulse responses of each macro variable to structural shocks using monthly Korean macroeconomic data for the full sample period from January 2003 to September 2015. The response results are reported up to 25 months after the shock. Each panel depicts impulse responses to macro shocks: risk premium; demand; and foreign, supply and aggregate spending shock, respectively.

run, but the response becomes negligible in the long run. The response of real output is insignificant, while the interest rate initially rises but soon decreases, implying a negative correlation with exchange rate in the long run.

The fourth column shows the impulse responses to supply shock. Stock returns, inflation and the foreign exchange rate do not respond significantly to supply shock, while output growth responds positively throughout the whole horizon. Finally, interest rate drops in the short run but rises after 10 months and shows a positive accumulated response in the long run, although the result is not significant. The last column displays impulse responses to aggregate spending shock, derived mainly from an increase in the interest rate. A positive aggregate spending shock has an initially positive effect on stock returns, but this soon diminishes to zero over time. The effect of aggregate spending shock on inflation is positive in the short run, reflecting the price puzzle, as shown in the noncrisis-period sample. An interest rate increase (from aggregate spending shock) leads to a decrease in the won–US dollar exchange rate (appreciation of the Korean won) and a long-run decrease in real output growth.

The FEVD on KOSPI stock returns shows results slightly different from those in the three-variable case. As shown in Figure 6, the role of demand shock is almost equivalent to that of risk premium shock, where each consists of 40%–45% of total variance over different horizons. The role of demand shock increases over time, while that of risk premium shock decreases. Note that, in the three-variable model, risk premium shock dominates the variance of stock returns. Foreign risk shocks are the least important determinant. The role of supply shock is quite small in the short run but increases over time.

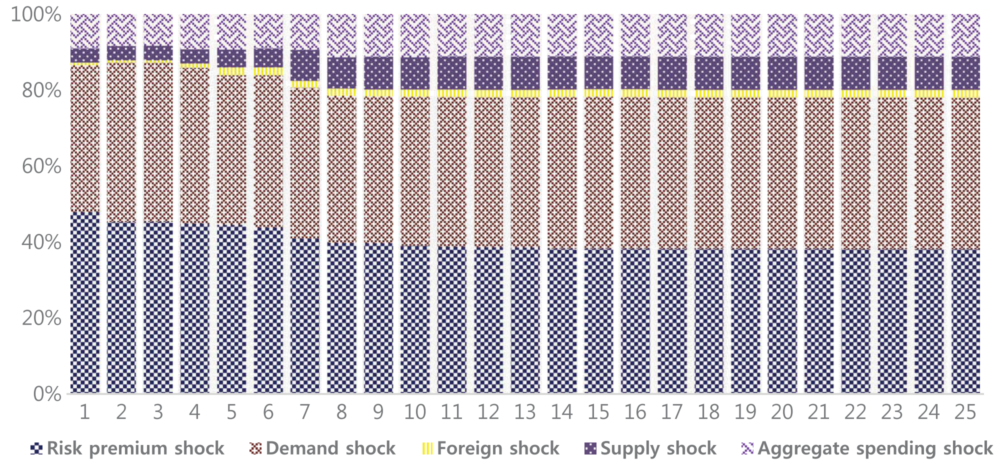

Figure 6. Forecast error variance decomposition of KOSPI stock return: five-variable model.

Note: This figure presents a decomposition of forecast error variance in KOSPI stock returns resulting from supply shock, demand shock, interest rate shock (aggregate spending shock), foreign shock and risk premium shock.

VII. Conclusion

This article examines the correlation of major macro shocks – risk premium, demand and foreign risk; supply; and aggregate spending shocks – with key macro variables, including stock returns, using three- and five-variable SVAR models. The models are estimated using monthly Korean market data covering the sample period from January 2003 to September 2015, and are further estimated with a sub-period that excludes the GFC period. In the three-variable model, we adopt a nonzero z ratio restriction for the long-run identifying restrictions to allow for economically meaningful relationships among the variables.

Overall, our empirical results on impulse responses and FEVD analyses are in line with the findings in the literature and with standard economic theories. Demand shocks have positive initial effects on stock returns, but these positive effects disappear in the long run, showing a negative relationship. Supply shocks, on the other hand, have negative effects on stock returns in the short run, but these effects become positive in the long run. As for risk premium shocks, they have a negative relation with inflation and a strongly positive relation with real output growth, which is consistent with prior findings. The sub-period analysis shows that the market fluctuations during the GFC period have relatively little effect on the Korean stock market. Finally, the FEDV shows that the risk premium shock is the leading determinant of volatility in stock returns, while demand shocks have much stronger effects on return volatility than supply shocks have.

That macro shocks have significant effects on stock returns is well-known. Our empirical results confirm the validity of the SVAR model in verifying this result, even in an expanded model with three and five variables. Our results also confirm that the traditional relationship between macro variables and stock returns found in the literature can be applied to the case of Korea. Our finding that the GFC period did not significantly affect the relationship between the macro variables and stock returns requires further investigation.

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