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Investigating the Interaction Between Terms of Trade and Domestic Economy: In the Case of the Korean Economy

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Yongseung Han
Department of Economics and Finance, University of North Georgia, USA

Myeong Hwan Kim
Department of Economics and Finance, Purdue University Fort Wayne, USA

Eun-Young Nam†
Department of Business Administration, Sejong University, South Korea

Abstract

Purpose – This paper aims to analyze the impact of the terms of trade, export price, and import price on the Korean economy (that is, real GDP, CPI, money market rate, and real effective exchange rate), and vice versa in the simple vector autoregression.

Design/methodology – We impose two assumptions, i.e., diagonality and bloc exogeneity, to correctly identify the impact of a factor to the others in the structural equation. With two contemporaneous assumptions in the structural VAR, this paper investigates the impacts of the terms of trade on the Korean economy and vice versa.

Findings – Impulse responses to the shocks in the terms of trade and Korean economy show that 1) an impact of the terms of trade on the economy is different in export prices and in import prices. A higher export price is beneficial to the economy while a higher import price hurts the economy, and 2) an increase in real effective exchange rate and in interest rate constrains domestic production and lowers consumer prices.

Originality/value – Unlike the conventional perception that a depreciation of a currency would promote exports and domestic production at the price of inflation, our result shows the opposite, and 3) real GDP and consumer prices are positively correlated. That is, an increase in real GDP does not only cause inflation, but an increase in consumer prices also promote domestic production. Yet, the only difference is that export prices and import prices end up higher with an increase in real GDP, but lower with inflation.

Keywords: Impulse Response, Korean Economy, Structural VAR, Terms of Trade
JEL Classifications: C15, C22, F14

1. Introduction

International trade is crucial to the Korean economy as evidenced from the ratio of exports and imports to gross domestic product (GDP). The ratio in 2018 was 83%, and it was 110% at its peak in 2011. Thanks to international trade, the Korean economy has grown from an economy of $3.96 billion in 1960 to an economy of $1.62 trillion in 2018.

Korea's sustainable economic growth is hugely dependent upon foreign economies as Korea's trade with foreign countries plays a huge role in its economy. For this reason, the Korean economy has been modeled as a small open economy by which the Korean economy

† **Corresponding author:** nanyinying@sejong.ac.kr

is affected by foreign economies, while it does not affect foreign economies. In fact, the Korean economy fell to recession in 1997 due to a foreign currency crisis, but quickly recovered partly due to a tech boom in 1999. The Korean economy had difficult times when the global recession hit in 2007-2008.

Given the importance of international trade in the Korean economy, numerous studies have made to understand the impact of foreign sectors on the Korean economy and vice versa. Some studies, mostly from major research institutions, i.e., the Bank of Korea (BOK), the Korea Development Institute (KDI), and others, used a large model to forecast domestic macroeconomic variables. Some studies directly analyzed the impact of foreign exchange rate on the Korean economy and the correlation between major trading countries and Korea.

This paper aims to analyze the impact of the terms of trade (that is, export price and import price) on the Korean economy (that is, real GDP, CPI, money market rate, and real effective exchange rate) and vice versa in a simple vector autoregression. We impose two assumptions, i.e., diagonality and bloc exogeneity, to correctly identify the impact of a factor to the others in the structural equation. To lay out this paper, previous studies in the literature are summarized in the following section. Then, we develop the methodology to use a structural vector autoregression model with the assumptions in the next section. We show our empirical results on the impulse responses to a shock in the variables in the Section 4, and then a conclusive summary follows.

2. Literature Review

A primary tool to analyze and forecast macro-economic variables is a large-scale model based upon general equilibrium in an economy. For this reason, most major economic research institutions in Korea run their own large-scale macro-econometric models, e.g., Dynamic Stochastic General Equilibrium (DSGE), to make economic forecasts as well as quantify the impact of any policy changes and shocks on the economy. Although these models are most comprehensive in the scope of macroeconomic analysis, each model is designed to meet the objectives and the roles of the underlying institutions. and thus its main analysis is different. For example, the BOK04 model (Hwang Sang-Pil et al., 2005) focused on the impact of the changes in money market overnight rate, foreign exchange rates, oil price, and world trade volume, while the Korea Economic Research Institute (KERI) quarterly econometric model (Huh Chan-Guk, Kim Chang-Bae and Lee Yeon-Ho, 2005) focused on the impact of the changes in government expenditure, foreign exchange rate, import price, and world trade volume. On the contrary, the KDI-DSGE model (Lee Jae-Jeon et al., 2011) mainly focused on the impact of monetary policy and fiscal policy. The National Assembly Budget Office (NABO) quarterly model (Kim Hye-Sun, 2012) and the Korea Institute for Industrial Economics and Trade (KIET) model (Lee Jin-Myon et al., 2013) were also designed to meet the objectives of their institutions.[1]

A large-scale econometric model requires a huge amount of time and effort to develop and maintain in addition to Sims' Critique (1980) that it is difficult to identify endogenous variables and exogenous variables. For this reason, many of studies on the impact on the economy were made upon alternative methods, e.g., the Vector Autoregressive Regression (aka, VAR). For example, Kim So-Young (2011) analyzed the impact of the U.S. economy on the Korean economy using structural VAR, and Kim Yun-Yeong and Park Joon-Yong (2009)

[1] To explore the variety of the macro-econometric models even in the same institutions, see Lee Jin-Myon et al. (2013)

used a global VAR to analyze the impact of Korea's major trading partners on the Korean economy.

However, use of the VAR requires the identification of the parameters in the structural equations that must be based upon solid economic theory. The easiest way is to identify the shocks in the structural equations by the Cholesky decomposition of the covariance matrix from the reduced form equation (Bernanke, 1986). Then, a certain value, e.g., zero, that is based upon economic theory, e.g., long-run neutrality, is directed imposed on the coefficient of the reduced-form equation (Blanchard and Quah, 1989). This direct imposition of a certain value on the coefficient matrix of the reduced-form equation was further evolved to include short-run restrictions (Kim So-Young, 2003) and block exogeneity (Lastrapes, 2005). Another notable progress in the identification of the VAR was sign restrictions. On the proposition that the sign of the coefficient must be consistent with economic theory, Uhlig (2005) proposed that an estimation producing the "wrong" sign of the coefficient must be dropped in a repeated estimation.

Studies on macroeconomic analysis in Korea are abundant when other methods of estimation, e.g., panel data estimation and calibration, are included. We are not able to include all these studies. Nevertheless, we summarize some of the studies that are related to our study as our study is to analyze the Korean economy, which actively interacts with the foreign economies.

First, studies identify that the Korean economy is heavily influenced by foreign economies. Specifically, Park Hyung-Soo (1999) further moved to argue that the Korean economy was synchronized with foreign economies in investment and even in consumption. Kim Yun-Yeong and Park Joon-Yong (2009) noticed that the Korean economy was influenced most from China and the U.S. among Korea's major trading partners, adding that real sectors of the foreign economies immediately affected domestic variables in Korea, while the financial sectors of the foreign economies gradually affected the domestic variables in Korea. Narrowing it down to the bilateral relation between the U.S. and Korea, Kim So-Young (2011) found that a supply shock from the U.S. had a larger impact on the Korean economy than did a demand shock from the U.S. Given the substantial evidence that the Korean economy is affected by the foreign economies, Lee Han-Gyu (2011) argued that inflation targeting only on non-tradable goods brings the largest social welfare.

Second, most studies provide empirical evidence that an increase in exchange rate (that is, a depreciation of the Korean currency, won) lifted domestic production and exports while suppressing imports with a higher price level (Hwang Sang-Pil et al., 2005; Lee Jin-Myon et al., 2013). However, Yoon Deok-Ryong and Kim Hyo-Sang (2017) argued that such empirical evidence is valid only when manufacturing industries are central in an economy, providing opposite evidence that an increase in the exchange rate reduced domestic consumption and domestic investment as real income decreased with a higher price level, and the production costs increased with imported intermediate goods and raw materials.

Third, studies agree that a decrease in interest rate, initiated by the monetary authorities, promotes economic activities and thus leads to higher GDP and improvement in trade balance. However, the impact of a rate cut on inflation seems to be rather mixed. While most studies support the conventional perception that contractionary monetary policy helps disinflation (Hwang Sang-Pil et al., 2005; Lee Jae-Jeon et al., 2011; Lee Jin-Myon et al., 2013), Huh Chan-Guk, Kim Chang-Bae and Lee Yeon-Ho (2005) argued that the GDP deflator, a wide measure of price, increased from the second year when the interest rate was cut.

3. Structural VAR

3.1. Structural VAR

We consider a structural vector autoregression (VAR) to analyze how terms of trade affect a domestic economy, and vice versa. A VAR model is desirable over large-scale statistical macroeconometric models in analyzing economic relations because a VAR model is not only simpler in the use of economic variables but it is also credible in the identification of excluded variables (Sims, 1980). Following this benefit, we assume that the economy is described by the structural form equations

$$A_0 y_t = A_1 y_{t-1} + \cdots A_p y_{t-p} + u_t \tag{1}$$

where $Eu_t u_t^T = I$ and $A_0, A_1, \cdots, A_p$ are the matrices of coefficients to the economic variables of interest, and y_t, $y_{t-1}, \cdots, y_{t-p}$, respectively. The subscripts of the variables indicate time so that current and lagged variables are distinguished. Since we are interested in the interactions between foreign economy and domestic economy, y_t is composed of 2 blocks, terms of trade and domestic economy, where terms of trade are the results of foreign economy and domestic economy

$$y_t = \begin{pmatrix} y_{1t} \\ y_{2t} \end{pmatrix} \tag{2}$$

where y_{1t} denotes terms of trade, i.e., export price and import price, and y_{2t} denotes domestic macroeconomic variables, i.e., real GDP, CPI, interest rate, and real effective exchange rate, as do all lagged variables.

However, the above structural VAR model cannot be directly estimated as A_0 is attached to the dependent variables y_t unless it is correctly identified from the reduced-form estimation. Therefore, we estimate the following reduced-form equations

$$y_t = B_1 y_{t-1} + \cdots + B_p y_{t-p} + \varepsilon_t \tag{3}$$

where $E\varepsilon_t \varepsilon_t^T = \Omega$ and $B_1, B_2, \cdots, B_p$ are the matrices of coefficients to the economic variables of interest.

Equations (1) and (3) are related in a way that $B_1 = A_0^{-1}A_1, \cdots, B_p = A_0^{-1}A_p$ and $\varepsilon_t = A_0^{-1}u_t$. That is, it is possible to identify all *A* matrices from the estimation of *B* matrices from this relation. However, such identification is not allowed unless we restrict the coefficients of the *A* matrices as the number of the coefficients in *A* matrices are larger than the number of the coefficients estimated in *B* matrices. To identify *A* matrices, we impose 2 restrictions on A_0, contemporaneous diagonality and block exogeneity. Any restrictions on *A* matrices must be reasonable either to economic theory or economic data.

The first assumption is contemporaneous diagonality in terms of trade. That is, export price and import price are independently determined, and thus not correlated in the current period, although they are affected by each other in the end. Export price is determined mostly by domestic production costs and foreign demand, while import price is determined by domestic demand and foreign production costs. Obviously, domestic demand and foreign demands are not identical, and production costs in the domestic economy and in the foreign economy are not fully synchronized. Thus, export price and import price are not correlated. As you will notice in Figure 1, the time trend of export price is different from the time trend

of import price.

The second assumption is block exogeneity, indicating that the economy is a small open economy in which the domestic economy is affected by the foreign economy, while the domestic economy does not affect the foreign economy. It has been a norm that the Korea economy is a small open economy in the literature, and thus the impact of the foreign economy is exogeneous to the Korean economy.

The restrictions of the assumptions are imposed on A_0. Since we have 2 blocks in the model, the terms of trade block and domestic economy block are

$$A_0 = \begin{pmatrix} A_{11}^0 & A_{12}^0 \\ A_{21}^0 & A_{22}^0 \end{pmatrix} \tag{4a}$$

where A_{11}^0 shows the interactions between export price and import price, A_{12}^0 shows the impact of the domestic economy on the foreign economy channeled via terms of trade, A_{21}^0 shows the impact of foreign economy channeled via terms of trade on the domestic economy, and A_{22}^0 shows interactions within the domestic economy. The first assumption that export price and import price are independently determined and thus not correlated in the current period is to have

$$A_{11}^0 = \begin{pmatrix} a_1 & 0 \\ 0 & a_2 \end{pmatrix}, \tag{4b}$$

and the second assumption that the Korean economy is a small open economy is to have

$$A_{12}^0 = 0 = \begin{pmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix} \tag{4c}$$

The main focus is to find how much one factor affects the other factors. To find the impact, we estimate the impulse response function. Given the structural form equation (1) and the reduced form equation (3), we have the following moving-average forms to derive impulse responses

$$\begin{aligned} y_t &= (D_0 + D_1 L + D_2 L^2 + \cdots) u_t \\ &= D(L) u_t \end{aligned} \tag{5a}$$

for the structural form equation, and

$$\begin{aligned} y_t &= (I + C_1 L + C_2 L^2 + \cdots) \varepsilon_t \\ &= C(L) \varepsilon_t \end{aligned} \tag{5b}$$

for the reduced form equation where $D(L)$ and $C(L)$ are a matrix polynomial in lag operator L. Both $D(L)$ and $C(L)$ show the impulse responses from the different time periods. This is what we estimate in the paper.

3.2. Data

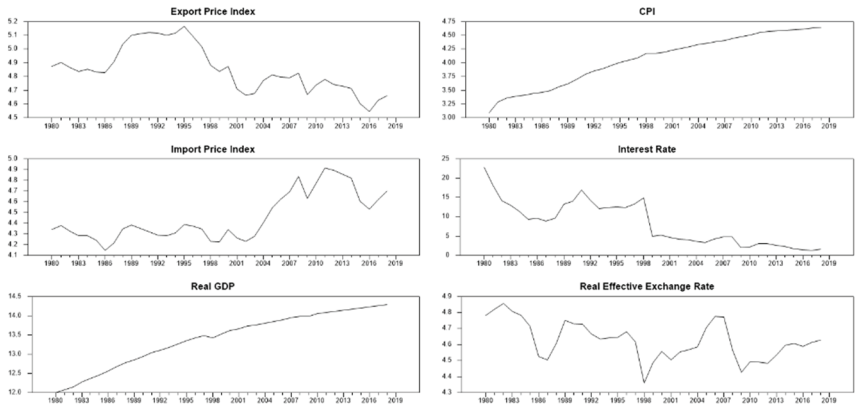
We chose to use 6 variables. 2 variables, i.e., export price index and import price index, for the terms of trade, and 4 variables, i.e., real gross domestic product, consumer price index, interest rate, and real effective exchange rate, for the Korean domestic economy. Data for the

variables are annual from 1980 to 2018 to see longer relations among variables. Below shows the explanation of the data.

Export price index (*EXP*), import price index (*IMP*), and consumer price index (*CPI*) were collected from the Economic Statistics System (*ECOS*) at the Bank of Korea. The base year of the price indices is 2015 so that *EXP*, *IMP* and *CPI* are all set at 100 in 2015. Both *EXP* and *IMP* are compiled based on the contract currencies so that the indices reflect the demand and supply in the international markets.

Real gross domestic product (*RGDP*) and real effective exchange rate (*REER*) are collected from the Federal Reserve Economic Data (FRED) at the Federal Reserve Bank at St. Louis. REER is based on manufacturing consumer price indices of Korea's trading partners. For interest rate, we chose the money market rate because the other interest rates do not have enough time series to be covered for the analysis, and the money market rate is directly affected by the Bank of Korea's open market operations. The money market rate (*MMR*) was collected from the International Financial Statistics of the International Monetary Fund. All variables are annual data. Figure 1 shows the time trend of the variables in our dataset.

Fig. 1. Time Trend of Data



3.3. Identification Strategy

To identify A matrices from estimated B matrices, the relation between structural form equation (1) and the reduced form equation (3) must be recognized

$$y_t = A_0^{-1}A_1 y_{t-1} + \cdots + A_0^{-1}A_p y_{t-p} + A_0^{-1}u_t$$
$$y_t = B_1 y_{t-1} + \cdots + B_p y_{t-p} + \varepsilon_t \quad (6a)$$

That is,

$$B_i = (A_0)^{-1}A_i \text{ and } \varepsilon_t = A_0^{-1}u_t \quad (6b)$$

Given the relations of (6b), the assumptions of contemporaneous diagonality and block exogeneity simplify the estimation of the reduced form equation (3), as proved by Hamilton (1994, pp. 309-311) and used by Lastrapes (2005/2006). That is, the equation (3) can be

estimated as below;

$$y_{1t} = \sum_{i=1}^{p} B_{11}^{i} y_{1t-i} + e_{1t} \tag{7a}$$

$$y_{2t} = G_0 y_{1t} + \sum_{i=1}^{p} B_{22}^{i} y_{2t-i} + \sum_{i=1}^{p} (B_{21}^{i} - G_0 B_{11}^{i}) y_{1t-i} + e_{2t} \tag{7b}$$

where $H = E e_{2t} e_{2t}^{T} = \Omega_{22} - \Omega_{21}\Omega_{11}^{-1}\Omega_{12}$, $G_0 = \Omega_{21}\Omega_{11}^{-1}$ and $G_{21}^{i} = B_{21}^{i} - G_0 B_{11}^{i}$. From (6b), the covariance matrix of the reduced form equation Ω is now related to A_0 as seen below

$$\Omega = \begin{pmatrix} \Omega_{11} & \Omega_{12} \\ \Omega_{21} & \Omega_{22} \end{pmatrix} = A_0^{-1}(A_0^{-1})^{T} \tag{8}$$

where $\Omega_{11} = (A_{11}^{0})^{-1}(A_{11}^{0})^{-1T}$, $\Omega_{12} = -(A_{11}^{0})^{-1}(A_{11}^{0})^{-1T}(A_{21}^{0})^{T}(A_{22}^{0})^{-1T}$, $\Omega_{21} = \Omega_{12}{}^{T}$, and $\Omega_{22} = (A_{22}^{0})^{-1}A_{21}^{0}(A_{11}^{0})^{-1}(A_{11}^{0})^{-1T}(A_{21}^{0})^{T}(A_{22}^{0})^{-1T} + (A_{22}^{0})^{-1}(A_{22}^{0})^{-1T}$. From (8), we can see that the covariance matrix of (7b) is symmetric and the product of the inverse matrix of A_{22}^{0} and its transpose.

With this information, A_0 is identified in the following procedures. First, we get $H = E e_{2t} e_{2t}'$ from the estimation of (7a) and (7b). The Cholesky decomposition of H yields a lower triangular matrix, p, i.e., $H = pp^{T}$, by which we get A_{22}^{0}. That is, $p = \left(A_{22}^{0}\right)^{-1}$. Second, from $\Omega_{11} = (A_{11}^{0})^{-1}(A_{11}^{0})^{-1T}$, on which the contemporaneous diagonality assumption is imposed, A_{11}^{0} is obtained to be $A_0^{11} = \begin{pmatrix} 1/\hat{\varepsilon}_1 & 0 \\ 0 & 1/\hat{\varepsilon}_2 \end{pmatrix}$. Third, A_{21}^{0} is obtained by using the relation, $G_0 = \Omega_{21}\Omega_{11}^{-1}$.[2]

Once A_0 is identified, it is typical to recover a matrix polynomial, i.e., $D(L)$, to find the impulse response function from the structural from equation.

4. Results on Impulse Response

We follow the standard estimation procedure adopted for the structural VAR literature. That is, we first estimate (3) and then use the identification strategy laid out in the previous section to obtain (4a). By using (4a), we estimate (5a) for impulse response. Impulse response, which should be correctly identified in the structural equation, is useful to analyze how a shock to a variable affects another variable.

In this standard procedure, we chose the lag length and tested if the variables in the domestic economy are exogenous to the variables in the terms of trade. To choose the optimal lag length, we applied Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC). It turns out that both AIC and SBC indicate only one lag. To see if domestic variables are exogeneous to the terms of trade, we performed the likelihood ratio test by which we reject a null hypothesis that the domestic variables are exogenous.[3]

The following shows the impulse responses to a shock in terms of trade, exchange rate, and other macroeconomic variables.

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[2] With the estimated G_0, we get $G_0\Omega_{11} = \Omega_{22}$ where $\Omega_{21} = -(A_{22}^{0})^{-1}A_{21}^{0}(A_{11}^{0})^{-1}(A_{11}^{0})^{-1T} = -(A_{22}^{0})^{-1}A_{21}^{0}\Omega_{11}$ that can be further simplified as $A_{22}^{0}G_0\Omega_{11}\Omega_{11}^{-1} = -A_{21}^{0}$. Since $\Omega_{11}\Omega_{11}^{-1} = I$, we get $A_{22}^{0}G_0 = -A_{21}^{0}$. As A_{22}^{0} is known through the first step on the above, we can get A_{21}^{0}.

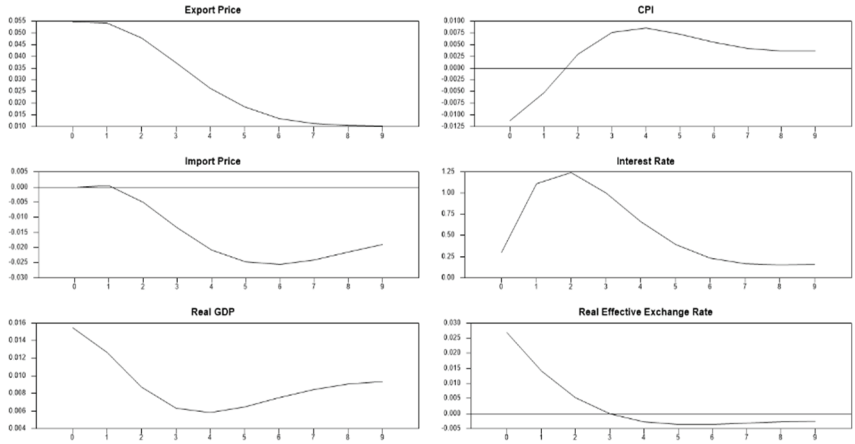
[3] The Chi-Square statistic with the degree of freedom = 8 is 46.709 with the significance level 0.0001.

4.1. Export Price

A shock can occur to Korea's export prices. For example, Korea's export price can jump if foreign demand for Korean products increases, e.g., due to a boom in the foreign economy, or fall if foreign demand for Korean products decreases, e.g., due to a global recession. A shock is positive if Korea's export price increases, and it is negative if Korea's export price decreases.

Consistent with the theoretical presumption that a global economic boom would improve the terms of trade of a small open economy and thus be positive for a small open economy, a positive shock in export price immediately increases domestic production, exchange rate, and interest rate. That is, as shown in the Fig. 2, a global boom increases the demand for Korean products, and thus increases Korea's export price. The heightened export price encourages domestic investment and thus domestic production (*RGDP*) while corresponding with higher level of exchange rate (*REER*). As domestic investment increases, higher demand for loanable fund lifts domestic interest rates (*MMR*). A higher level of production and exports increase domestic income, eventually leading to a higher demand for domestic products and thus consumer prices (*CPI*) eventually reach a higher level. As interest rates climb to a higher level, the increase in exchange rate diminishes. As the exchange rate cools, Korea's import prices (*IMP*) fall.

Fig. 2. Impulse Response to a Shock in Export Price



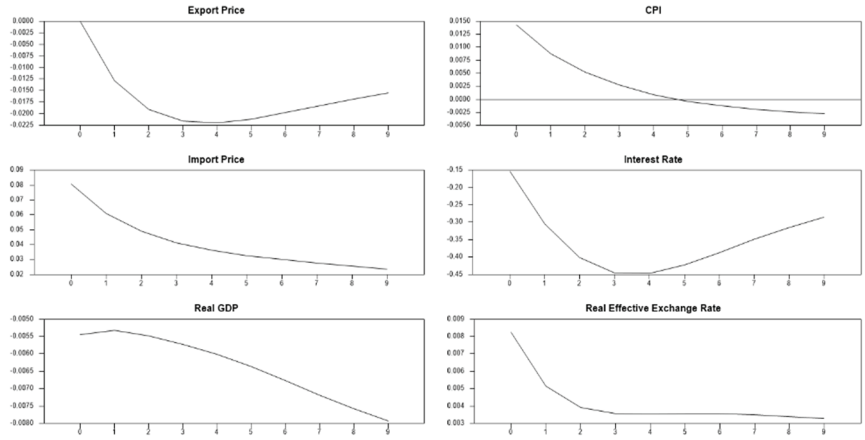
4.2. Import Price

Korea's import price can jump if a sudden inflation in natural resources, e.g., oil, transmits to Korea, or plunge if a global recession drags down a global demand for Korean products. An increase in Korea's import price deteriorates Korea's terms of trade and is negative to the Korean economy, while a decrease in the import price improves the terms of trade, and thus is positive for Korea.

The theoretical presumption is that Korea's import price would jump (and its terms of trade deteriorates), and thus a small open economy would be negatively hit if a negative shock occurs. Consistent with this presumption, a negative shock in import price, e.g., oil shock, results immediately in higher import prices (*IMP*) and thus in domestic prices (*CPI*), which

negatively affect domestic consumption. On the contrary, weak demand in the foreign economy lowers Korea's export price (*EXP*). Deterioration in the terms of trade, resulting from an increase in import price, decreases imports and thus domestic investment. As domestic investment and consumption fall, domestic production (*RGDP*) shrinks. Nominal interest rates (*MMR*) fall due to weak investment and consumption. Due to a worsening current balance and a weak economy, the exchange rate (*REER*), in an immediate response to a negative shock, jumps. A higher exchange rate eventually reduces the current deficit. As the economy weakens further, consumer prices slowly fall to the previous level. The exchange rate and current deficit shrinks as shown in Fig. 3.

Fig. 3. Impulse Response to a Shock in Import Price

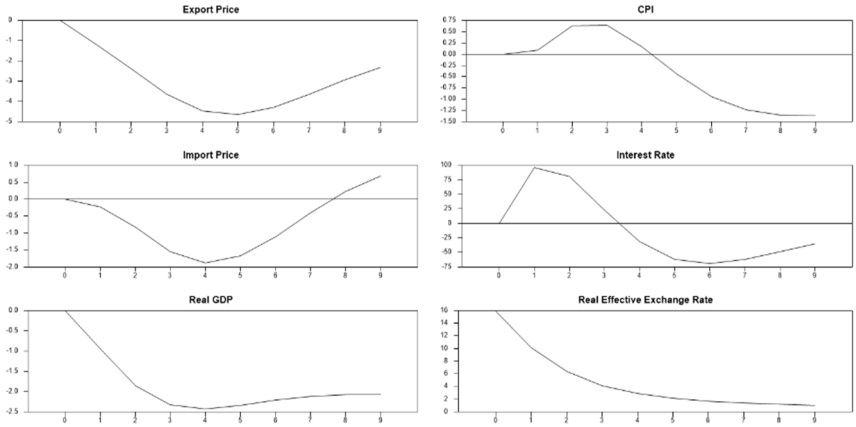


4.3. Real Effective Exchange Rate

The real effective exchange rate jumps if the nominal exchange rate jumps or a relative price of domestic products in terms of foreign products increases. The real effective exchange rate falls if the nominal exchange rate falls or a relative price of domestic products in terms of foreign products drops. In general, an increase in the real effective exchange rate enhances the price competitiveness of domestic products. Thus, a jump in the real effective exchange rate will be a positive shock to a small open economy. However, the impact of a change in the real effective exchange rate is rather complicated as the impact of the nominal exchange rate is complicated. Against the positive effect on exports when the nominal exchange rate rises, an increase in the exchange rate could shrink domestic spending due to a higher cost from foreign materials (Krugman, 1978; De Melo et al., 1996; Yoon Deok-Ryong and Kim Hyo-Sang, 2017).

Given the opposite effects of the exchange rate, Fig. 4 shows the impulse responses to a shock in the real effective exchange rate. An increase in the real effective exchange rate first lowers export prices and import prices. When a shock increases the exchange rate as well as its foreign exchange risk, the inflow of foreign funds or foreign borrowing decreases, and thus an increase in domestic borrowing leads to a higher interest rate (*MMR*) which, in turn, reduces domestic spending and thus domestic production (*RGDP*). As domestic production lowers domestic income, any increase in consumer prices (*CPI*) is only short-lived.

Fig. 4. Impulse Response to a Shock in the Real Effective Exchange Rate

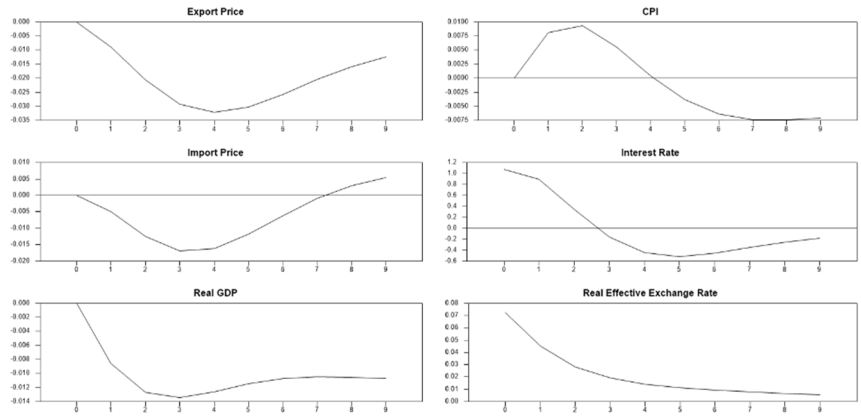


4.4. Money Market Rate

The money market rate, a Korean version of the Federal Fund rate, is closely watched by the Bank of Korea, the central bank in Korea, as it is the important path for the monetary policy to be transmitted to the financial sector. Thus, the money market rate jumps if the monetary authorities intend to tighten monetary aggregates. It drops if the monetary authorities decide to loosen monetary aggregates.

As shown in Fig. 5, an increase in interest rate due to a shock intended to tighten domestic spending decreases aggregate demand. As aggregate demand decreases, domestic production (*RGDP*) as well as price level (*CPI*) eventually fall in the long run. As overall price level falls, the relative price of Korean products to foreign products increases, leading to an increase in the real effective exchange rate. As price level falls, both export and import prices also decline. It should be noted that these responses are very similar to those of the real effective exchange rate.

Fig. 5. Impulse Response to a Shock in the Money Market Rate



4.5. Real GDP and Consumer Price Index

A shock to domestic production can occur if a massive scale natural disaster, e.g., typhoon or earthquake, unexpectedly hits an economy, or if bubbles in assets bring about a wealth effect. A shock is positive if it increases real GDP, and negative if it decreases real GDP. As seen in Fig. 6, it is not difficult to presume that an increase in real GDP eventually increases the prices of goods and services (*CPI*) as well as export price (*EXP*) and import price (*IMP*). As inflation picks up, monetary authorities attempt to tighten monetary aggregates, leading to a higher interest rate (*MMR*). According to interest rate parity, a higher interest rate should induce inflows of foreign funds, but the real effective exchange rate gradually increases to the contrary. It is a puzzle, although the exchange rate does not overshoot.

Fig. 6. Impulse Response to a Shock in Real GDP

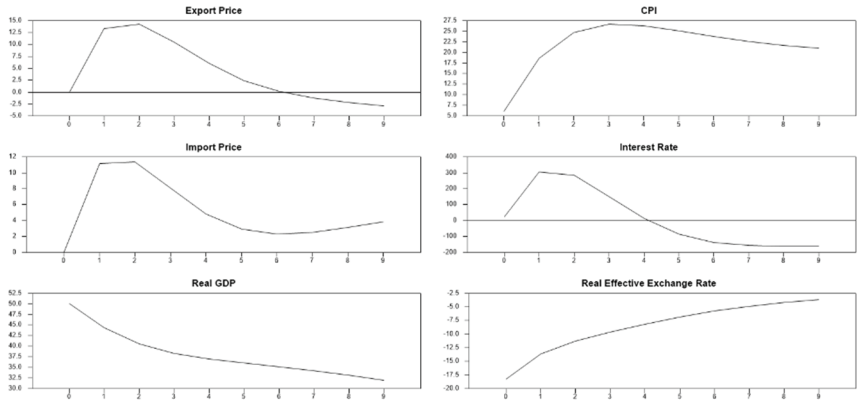
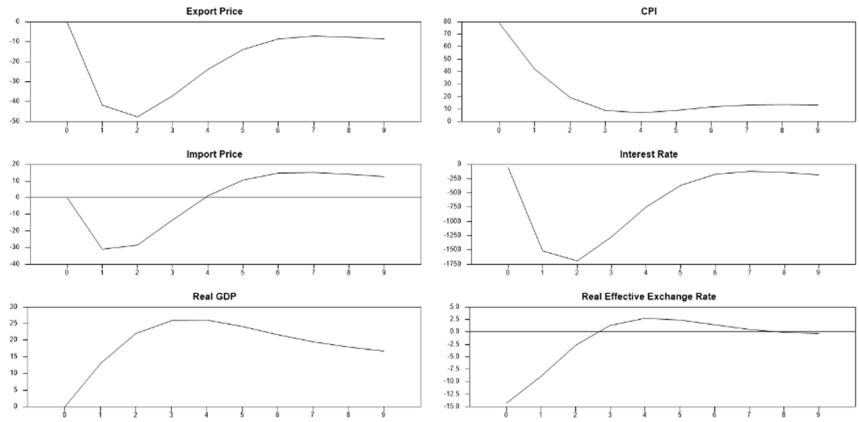


Fig. 7. Impulse Response to a Shock in Consumer Price Index



A shock can also occur to consumer prices (*CPI*) if consumer sentiments are affected by unaffected events, e.g., geo-political risks or sport games. A shock is positive if consumer prices increase, and negative if prices decline. A positive shock in consumer prices lowers a

real effective exchange rate, and thus price competitiveness of Korean products, resulting in the deterioration of the terms of trade. Korean exports and imports respond to the deterioration in the terms of trade by lowering export prices (*EXP*) and import prices (*IMP*). An initial decline in the real effective exchange rate would reduce borrowing demand for arbitrage in foreign exchange and, as its demand for arbitrage transaction decreases, the interest rate (*MMR*) begins to fall and the exchange rate begins to rebound. As the exchange rate rebounds, export prices (*EXP*) and import prices (*IMP*) recover, and thus domestic production (*RGDP*) gradually increases. These responses are shown in Fig. 7.

5. Conclusion

This paper investigated the impact of the terms of trade, i.e., export prices and import prices, on domestic variables in Korea (as well as the impact of the domestic variables, i.e., real GDP, consumer prices, interest rates, and exchange rate, on the terms of trade to enhance the understanding of the economy as well as to help make better policy decisions. To analyze these impacts, we obtained impulse responses to various shocks in the terms of trade and the domestic variables in Korea in a structural VAR framework. Two contemporaneous assumptions were imposed to correctly identify the various shocks to the variables of interest. The first assumption was the diagonality between the terms of trade, and the second assumption was block exogeneity of the terms of trade with respect to domestic variables. These assumptions are based upon a theoretical support on a small open economy as well as supported by data.

Table 1. Summary of Impulse Responses

A Positive Shock in	Positive Response in	Negative Response in
Export Price (*EXP*)	*RGDP, REER, MMR, CPI*	*IMP*
Import Price (*IMP*)	*REER, CPI*	*RGP, MMR, EXP*
Real GDP (*RGDP*)	*CPI, EXP, IMP*	*REER, MMR*
Consumer Price (*CPI*)	*RGDP*	*REER, MMR, EXP, IMP*
Interest Rate (*MMR*)	*REER* *CPI* (eventually lower)	*EXP, IMP, RGDP*
Real Effective Exchange Rate (*REER*)	*CPI* (eventually lower) *MMR* (eventually lower)	*EXP, IMP, RGDP*

This paper lays out how the assumptions of diagonality and block exogeneity are implemented in structural VAR and shows the impulse responses to shocks in the terms of trade and domestic variables. Table 1 on the above summarizes these results. First, the impact on the terms of trade on domestic macroeconomic variables is different in export prices and in import prices. A jump in export price is beneficial to the Korean economy, while a jump in import price hurts the economy. Second, an increase in the real effective exchange rate and interest rate contracts domestic production and lowers consumer prices. Specifically, unlike the conventional perception that the depreciation of a currency promotes exports and domestic production at the price of inflation, our results show the opposite. Third, real GDP and prices are positively correlated. That is, an increase in real GDP not only causes inflation, but an increase in consumer prices also promotes domestic production. Yet, the only difference is that export prices and import prices end up higher with an increase in real GDP, but lower with inflation.

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