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A Study on Economic Linkages between Korea and Japan

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Abstract

This paper investigates how Japanese economic shocks affect the Korean economy and analyzes the channels through which they are transmitted. Also, the relative importance of domestic and foreign shocks on the dynamics of certain key macro variables is investigated. The techniques of vector autoregression (VAR) are employed to investigate the international transmission of economic disturbances. The VAR methodology is a particularly useful means for characterizing the dynamic relationships among economic variables without imposing certain types of theoretical restrictions. The dynamic effects of Japanese economic shocks on the Korean economy are evaluated by estimating variance decompositions (VDCs) and impulse response functions (IRFs). This study supports the notion of economic dependence of a small open economy such as Korea to a large economy such as Japan.

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Ⅰ. Introduction

Since Korea launched its first five-year economic development plan in 1962, Korean government adopted an economic development strategy through export promotion. This strategy is largely due to the small size of Korean economy. As a consequence of the outward-oriented development strategy, Korea has been highly dependent on foreign trade and the Korean economy has become more open and interdependent with other countries. Namely, economic disturbances originating in other countries have an influence on the Korean economy through various channels.

It is widely perceived that Japanese economy has a direct effect on the Korean economy. Japan, together with the U.S., is the major trading partner of Korea. Actually, Japan accounts for a considerable amount of Korea's exports and imports. To the economic policymakers, it is very important to know how economic disturbances generated by Japan are transmitted to the Korean economy.

This study aims to examine how Japanese economic shocks affect the Korean economy and the channels through which they are transmitted. The relative importance of Korean and Japanese economic shocks on the dynamics of certain key macro variables is also investigated.

A vector autoregression (VAR) model is employed to investigate the international transmission of economic disturbances. The dynamic behavior and interactions of the Korean-Japanese economy are investigated by using variance decompositions (VDCs) and impulse response functions (IRFs).

The VAR system contains variables for Korea and Japan, and uses monthly data form May, 1985 to June, 2002. This data set provides a sufficient number of observations to estimate the system. We might expect Japanese economic shocks to influence the Korean economy, since Japan is one of the largest trading partners of Korea.

Ⅱ. Empirical Methodology

The recent empirical studies analyzing the effects of international disturbances were performed by Darby and Lothian (1989), Burdekin (1989), Moreno (1990), and Lastrapes and Koray (1990). Using different techniques, the above studies indicate that domestic economies are dependent upon foreign variables, even though the channels of such influence differ across the countries.[1)]

This study investigates issues of economic interdependence between Korea and Japan using the VAR methodology. The methodology employed in this paper allows us not only to use a measure of the relative importance of Japanese economic shocks for Korean economy, but also to analyze the dynamic interactions of Japanese and Korean variables. The following section describes the methodology that will be used in this study.

1. VAR Methodology

A vector autoregression can be viewed as a system of reduced form equations in which each variable is regressed on a vector of past values of all variables in the system. Each variable in the system acts as an endogenous variable, and is decomposed into a component that is predictable from the past values of all variables, and an unpredictable innovation.[2)]

The VAR methodology employed in this paper does not impose

1) Lastrapes and Koray (1990) investigated the international transmission of aggregate shocks between the U.S. and three major European countries (the United Kingdom, France and Germany) under fixed and flexible exchange rate regimes in the context of vector autoregression models. They found that the channels through which shocks are transmitted differ across three countries, though the three European economies react to the U.S. shocks.

2) In the reliability and usefulness of VAR methodology, see Cooley and LeRoy (1985), Kuszczak and Murray (1987), and Runkle (1987).

exogeneity on any variable in the system. It can isolate the dynamic effects on, and the relative importance to, the variables in the system of a shock to any one variable. This allows the model to capture a wide range of transmission channels. Therefore, VAR techniques that analyze the mechanisms through which Japanese economic shocks are transmitted to the Korean economy are well-suited for this purpose. In studying international transmission of economic disturbances it is important to know something about the direction of causality. The VAR method makes this possible by employing Granger-causality tests and variance decompositions.

In addition, we can measure the relative importance of Japanese and domestic shocks for the Korean economy by the forecast error variance decomposition proposed by Sims (1980a) and the recognition of the transmission mechanisms revealed by the data is provided by the impulse response functions (IRFs).

In this study, the IRFs indicate how Japanese innovations are dynamically transmitted to the Korean economy and the variance decompositions (VDCs) measure the contribution of each shock in the system to the forecast error variance of the dependent variables. In the context of this study, the VDCs are useful for measuring the relative importance of Japanese economic shocks on the Korean economy.

The VAR model with monthly data containing nine variables can be written as

$$yt = A(L)yt + ut$$

$$E(ut) = 0,$$
$$E(utut') = \Sigma,$$
$$E(utus') = 0 \qquad t \neq s.$$

Where yt = a 9×1 vector of endogenous variables,

A(L) = lag polynomial (A1L + A2L2 + · · · · + ApLp)

L = lag operator defined by Lyt = yt - 1,

ut = a 9 × 1 vector of white noise disturbance terms assumed to be independent and normally distributed with zero mean.

To estimate the above equation is very easy. Ordinary least squares estimating equation by equation gives consistent estimates. However, it is difficult to interpret the empirical results. Therefore, the vector moving average (VMA) representation of yt is needed for the interpretation of VARs as proposed by Sims.[3)]

2. Data and Estimation

Since this study aims to investigate the degree to which Japanese economic shocks are transmitted to the Korean economy, data that properly represents the state of the Korean economy are needed and useful proxies for relevant Japanese economic disturbances are required.

It can be perceived that the state of Korean economy is well represented by the following four variables - the money supply, interest rate, price level, and output - the same as Sims' (1980b) study and the other VAR studies.[4)] This study chooses the same variables for Japan to represent external shocks. The Korean economy's close ties with Japan justify the choice of this nation as representing one of the major foreign factors.

Also, the nominal bilateral exchange rate (monthly average) is included in the VAR and measured as the foreign currency price of the Korean won.[5)]

3) We can form the VMA representation by inverting the VAR system employed in this paper. For the technical part, see Doan and Litterman (1988).

4) All economic data are defined on a monthly basis.

5) The empirical analysis is also conducted using real exchange rates to check the robustness of empirical results. The empirical results are not much different from those with the nominal exchange rate.

The estimation period ranges from May 1985 to June 2002. Our sample therefore contains 206 monthly observations. Before estimating the VAR system, this study transforms all variables into natural logs except the interest rates. It is common in the literature to achieve stationarity by representing all variables in differences.

To check data stationarity and choose log level or log difference of variables, this study performs unit root and cointegration tests. For unit roots, augmented Dickey-Fuller tests are performed. To find the test-statistic for each variable, a linear regression analysis is conducted. The log level of each variable except the interest rate is regressed on a constant, the trend, the log level of that variable lagged once, and the first difference of log level of that variable with lags one to fourteen. The lag length fourteen is selected following Schwert (1987).[6]

Table 1 presents the statistics of unit root tests. The test statistics show that only Japanese output is stationary, whereas the other variables appear to be nonstationary. Thus, we can use log levels of this variable for empirical study.

<Table 1> Unit Root Tests

KY	KMS	KPS	KR	WY	JY	JMS	JPS	JR
-2.58	-1.92	-1.54	-2.14	-2.97	-4.57	-2.46	-2.02	-3.05

Notes : All regressions contain a constant and a trend. Critical values based on Fuller (1976) are -3.99, -3.43, and -3.13 for the 1%, 5%, and 10% significance level, respectively.

Then, augmented Dickey-Fuller tests for cointegration are performed for variables except stationary series. If the null hypothesis of unit root (i.e., if we find unit root) cannot be rejected, the variables are not cointegrated. Table 2 shows the results of the cointegration test. The test statistics indicate

6) For monthly data, Sehwert points out that the lag length, 112, can be obtained as follows :
112 = Int {12(T/100)1/4}. T = sample size

that these series are not cointegrated. For these series, we can use log difference.

<Table 2>Cointegration Tests

KY	KMS	KPS	KR	WY	JMS	JPS	JR
-4.35	-3.82	-3.31	-2.73	-3.22	-4.33	-0.89	-2.92

Notes : Since JY is stationary, based on unit root test, all regressions are performed without this variable. The 5% critical value for this case is larger than 4.50, and the 10% is larger than 4.2, in absolute terms.

To specify lag length of the explanatory variables in the VAR system, a maximum lag length of 12 months is used. To determine the optimal lag length of each variable, likelihood-ratio tests are performed. By this procedure, we can use eight as the optimal lag length for the VAR system.

The sensitivity of variance decompositions and impulse responses can be affected by the orderings of the variables. In order to identify variable combinations with high correlation, this study examines the contemporaneous correlations of the residuals in the VAR system. If the residuals of variables are not significantly correlated, the order of variables makes little difference. To check whether variable orderings affect the empirical results significantly, the variance decompositions and impulse responses are recomputed by changing the order of the variables. For the robustness of this study, several orderings are considered and estimated. The other estimated variable orderings are (1) KMS, KPS, KR, KY, WY, JMS, JPS, JR, JY ; (2) KMS, KY, KPS, KR, WY, JMS, JY, JPS, JR ; (3) JMS, JR, JPS, JY, WY, KMS, KR, KPS, KY ; (4) JMS, JPS, JR, JY, WY, KMS, KPS, KR, KY.

In this study, it is important to determine whether there are any causal relationships between the Korean and Japanese variables. For this purpose Granger-causality tests are employed. For Granger causality, this paper performs F-tests. Through Granger-causality tests, we can check whether past values of a given variable are significant in a particular equation.

<Table 3> Critical Levels of F-statistics

DV	KMS	KR	KPS	KY	WY	JMS	JR	JPS	JY
KMS	0.01	0.07	0.26	0.03	0.37	0.05	0.40	0.22	0.08
KR	0.49	0.35	0.42	0.08	0.73	0.75	0.89	0.86	0.54
KPS	0.59	0.15	*	0.62	0.25	0.57	0.39	0.25	0.52
KY	0.12	0.96	0.50	*	0.04	0.39	0.35	0.06	0.50
WY	0.08	0.17	0.23	0.71	*	0.27	0.20	0.31	0.78
JMS	0.22	0.28	0.45	*	0.23	*	0.04	0.33	0.06
JR	0.94	0.45	0.02	0.42	0.03	0.41	0.05	0.24	0.72
JPS	0.77	0.76	0.07	0.76	0.22	0.43	0.71	*	0.07
JY	0.81	0.95	0.39	0.04	0.57	0.02	0.88	*	*

Notes : DV is the dependent variable. The critical level is the significance level at which the null hypothesis that all lagged coefficients of indicated right-hand-side variables are zero is rejected. * indicates a value of less than 0.01

Ⅲ. Empirical Results

Table 3 shows the critical levels of F-statistics in the VAR system. The empirical results of F-test indicate that Japanese variables do not cause Korean variables at the 5% significance level.

Table 4 reports the results of the variance decompositions at various horizons. The basic ordering of variable is: Korean money (KMS), interest rate (KR), price (KPS), output (KY), nominal exchange rate (WY), Japanese money (JMS), interest rate (JR), price (JPS), and output (JY).

Table 4 also presents two summary measures representing the relative importance of domestic and foreign shocks on the Korean economy. VF is the proportion of forecast error variance of Korean variable explained by all foreign shocks. This can be obtained by summing the last four columns at each horizon. VFR is the proportion explained by foreign shocks relative to the proportion explaind by all variables in the system except the dependent variable.

<Table 4> Variance Decompositions

	Innovation to										
h	KMS	KR	KPS	KY	WY	JMS	JR	JPS	JY	VF	VFR
Dependent Variable: KMS											
3	83.1	4.2	1.5	3.5	1.7	3.0	0.1	2.6	0.2	5.9	35.1
6	69.3	3.6	2.3	6.2	2.3	4.2	2.1	3.2	6.4	15.9	52.5
9	60.1	4.9	3.9	7.1	2.9	6.3	3.3	3.9	7.6	21.1	52.8
12	57.7	5.2	4.2	8.0	3.4	6.4	3.4	4.1	8.1	22.0	51.3
24	54.3	5.4	4.6	8.5	3.6	6.8	4.6	4.1	8.1	23.6	51.4
36	53.1	5.4	5.0	8.7	3.7	6.9	4.7	4.2	8.4	24.2	51.5
48	53.1	5.4	5.0	8.7	3.7	6.9	4.7	4.2	8.4	24.2	51.5
Dependent Variable : KR											
3	5.5	83.7	4.2	2.0	1.6	0.8	0.4	0.2	1.6	3.0	18.2
6	7.7	76.2	4.4	3.9	2.0	1.4	0.6	0.7	3.2	5.9	24.7
9	7.4	67.9	5.6	9.6	2.0	1.5	1.3	1.1	3.6	7.5	23.4
12	7.3	65.9	5.7	10.2	2.1	1.7	1.8	1.5	3.7	8.7	25.6
24	7.4	63.1	6.9	10.2	2.4	1.9	2.1	2.0	4.0	10.0	27.1
36	7.4	62.7	7.0	10.3	2.5	1.9	2.2	2.0	4.0	10.1	27.1
48	7.4	62.5	7.0	10.3	2.5	2.1	2.2	2.0	4.0	10.3	27.5
Dependent Variable : KPS											
3	0.3	1.7	90.2	0.4	0.1	0.7	1.5	3.1	2.0	7.3	76.8
6	3.5	5.9	78.9	2.0	0.3	1.3	1.9	3.2	3.0	9.4	44.3
9	3.0	7.3	72.4	5.5	1.5	1.7	2.1	3.3	3.3	10.4	37.5
12	3.2	7.6	71.6	5.7	1.7	1.7	2.1	3.1	3.2	10.1	35.7
24	3.4	7.6	68.8	6.2	3.1	1.7	2.1	3.1	3.2	10.1	33.2
36	3.5	7.8	68.7	6.2	3.3	1.7	2.3	3.0	3.4	10.4	33.3
48	3.5	7.8	68.6	6.4	3.3	1.9	2.3	3.0	3.4	10.6	33.5
Dependent Variable : KY											
3	3.3	0.7	1.8	84.4	5.6	0.7	0.9	0.2	2.5	4.3	27.4
6	4.3	1.7	2.6	67.2	7.4	7.0	3.4	3.6	2.7	16.7	51.1
9	4.4	2.2	3.6	64.4	7.4	7.0	3.4	4.5	3.0	17.9	50.4
12	4.7	3.0	3.9	60.0	9.0	7.3	3.8	4.9	3.5	19.5	48.6
24	4.8	3.2	4.0	57.9	9.0	7.0	4.2	5.4	4.6	21.2	50.2
36	4.8	3.3	4.0	57.3	9.0	7.0	4.3	5.4	4.8	21.5	50.5
48	4.8	3.3	4.0	57.1	9.0	7.0	4.3	5.5	4.9	21.7	50.7
Dependent Variable : WY											
3	2.8	3.8	1.2	1.2	84.8	3.3	1.4	1.1	0.4	6.2	40.8
6	5.4	6.8	1.8	4.1	73.6	3.2	2.4	2.0	0.9	8.5	32.0
9	5.8	6.8	4.6	5.1	67.6	3.3	3.8	2.2	0.9	10.2	31.4
12	6.5	6.9	4.6	5.3	65.1	4.0	3.8	2.5	1.3	11.6	33.2
24	6.5	7.3	5.0	5.6	63.2	4.1	4.0	2.7	1.5	12.3	33.5
36	6.6	7.3	5.1	5.8	62.8	4.1	4.0	2.7	1.7	12.5	33.5
48	6.6	7.3	5.1	5.8	62.8	4.1	4.0	2.7	1.7	12.5	33.5

Notes : h is the forecast horizon. VF is the proportion of forecast error variance of Korean variable explained by Japanese shocks. VFR is the proportion explained by Japanese shocks relative to the proportion explained by all variables in the system except the dependent variable.

In all cases, the contribution of own shocks in explaining forecast error variance of the Korean variables at a horizon of four years exceeds VF in the VAR system. This implies that the most important factor in explaining one variable's forecast error variance is its own shocks. In most cases, VF and VFR increase as the forecast horizon grows.

Japanese variables such as money supply, prices, and output explain a substantial portion of the forecast error variance of the Korean money supply. Japanese variables explain 24.2% of the variance of Korean money supply and 21.7% of the variance of Korean output after two years. This figure is larger than those of the other domestic variables except its own innovations. Shocks to Japanese money supply have a significant effect on Korean output after six months. Japanese external effects on the Korean variables reach their peak after three or four years.

The empirical results show that there is a certain degree of Korean monetary dependence on Japanese shocks. For external shocks on the exchange rate, innovations to Japanese variables have a substantial effect on the exchange rate.

The impulse response functions display the responses of all variables in the system to a one standard deviation shock to each variable. After computing the IRFs a Monta Carlo integration technique similar to that described in Doan and Litterman (1988) is employed to generate estimates of the standard errors of the IRFs. We can present several features from empirical results of IRFs. First, the positive innovations to the Japanese money supply lead to a statistically significant decrease in the Korean output. This result confirms the Mundell effect, i.e., the inverse transmission of monetary disturbances.[7] Second, innovations to the Japanese interest rates

7) The Mundell-Fleming model indicates that a foreign monetary contractions causes a

have no significant effect on the Korean interest rates. Third, Korean money supply responds significantly to the Japanese money supply innovations.

Ⅳ. Conclusions

This study investigates the extent of international transmission of economic disturbances using VAR techniques. The major purpose of this study is to analyze how Japanese economic shocks affect the Korean economy and the channels through which they are transmitted.

The relative importance of domestic and foreign economic shocks on the dynamics of certain key macro variables is also examined.

The following three points draw particular attention from this study. First, this study investigated whether Japanese economic shocks were important for the Korean economy during the sample period and the channels of transmission differed. The results of this study provide the evidence that Japanese economic shocks are important for the Korean economy during the sample period, though the channels of transmission differ. Second, we can draw some economic implications based on empirical results, even though there exist some limitations in interpreting VAR results economically. The transmission of Japanese disturbances to the Korean credit market represents some extent of monetary dependence. Finally, this study supports the notion of economic dependence of a small open economy such as Korea to a large economy such as Japan. However it is very important to mention that we cannot generalize these VAR results of international economic linkages to other countries.

The investigation of the transmission mechanism of foreign shocks on the Korean economy using an alternative VAR methodolgy (structural VAR) is worthwhile. In a structural VAR, the disturbances are defined by the

depreciations of the domestic currency. Thus, its effect at home is expansionary.

identification we make. As noted by Bernanke (1986), this alternative methodology is more appropriate to use when we attempt to discriminate among structural hypotheses. This is well beyond the scope of this study and left for future research.

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