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A STUDY ON THE ROLE OF EXPORT SUBSIDIES IN KOREA

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The purpose of this study is to identify the role of export subsidies in economic development using the evidence from Korea. The unrestricted vector autoregression (VAR) model is used to analyze the interactive dynamic behaviors among exports, export subsidies, foreign exchange rates, and outputs in Korea during 1981-1992. The major findings of this study can be summarized as follows: First, export subsidies have positively contributed to the export growth in Korea during 1981-1992. Second, among different types of export subsidies, export facility installation financing (S2) stands out in its positive role for the promotion of exports. Lastly, export subsidies, more specifically export facility installation financing(S2) and long-run export financing(S3), have positively contributed to the growth of industrial production in Korea. The policy implication of the study is that the export incentives can still act as important tools to overcome the market imperfections in knowledge and risk even after a country achieved a certain degree of economic development.

I. INTRODUCTION

The issue of strategic trade policy is a relatively recent subject of interest to economists. Traditional trade theories assert that small export taxes should normally be beneficial, whereas export subsidies should always be harmful.[1] Under certain specific conditions, however, a government policy of export subsidization can act as a strategic tool to raise its national welfare.[2] Although the analysis on

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[1] Of course, we assume that countries here are large under perfect competition. If a large country sets a small export tax, then net national welfare may rise. Government's tax revenue and domestic consumers' surplus gain by a small export tax are large enough to offset the domestic producers' welfare loss. As is the case of a tariff, a sufficiently small export tax rate is always welfare improving. In reality, however, it is difficult to calculate the optimal export tax rate. Small countries under perfect competition always hurt themselves if they make any deviation from free trade.

the role of export subsidies through the formalized models from new trade perspective is quite recent, there has been a considerable debate on the role of export subsidies in economic development for the last three decades. Despite a vast debate and literature on the subject, there is no consensus on the effectiveness of export subsidies. On the theoretic part, different assumptions adopted by different models generate even opposite policy implications. On the empirical part, static time horizon and limited data availability also confine the scope of the research.[3] The conclusions reached by the authors largely reflect their ideological beliefs in the role of government.

Although a consensus has been reached, at least in policy circles, that export-led growth can be an effective strategy for a successful economic development, little has been understood about what drives export-led growth, the unfettered market by itself or policy incentives. Nor is the nature of the linkage between manufacturing exports and economic development progress well understood. The focus of this study is centered on two key questions: 1) Is it effective for a government to subsidize its domestic firms for export promotion even after a country has achieved a certain degree of economic development?[4] 2) Does a certain type of export incentive have a stronger effect on export promotion, and if so, why?

This study will expand the scope of previous research on the role of export subsidies in several ways. First, the study incorporates dynamics into this empirical work by using the VAR model. Previous empirical studies have mainly focused on the static aspect of the subject. The VAR analysis is one of the best available tool to capture the dynamics among these variables of interest. Variables seem to be simultaneously related to each other with persistent effects. One of our main interests in this study concentrates on the dynamic responses of export performance to the changes in export subsidies. Second, one of the weaknes-

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[2] Brander and Spencer (1985); Eaton and Grossman (1986) specified and modeled this kind of behavior mainly focusing on the government-led competition between domestic and foreign monopolistic firms.

[3] For the empirical analysis on the relationship between export subsidies and export performance, see Nogues (1989), Tyler (1976), Coes (1979), World Bank (1983), Frank et al.(1975), Balassa et al. (1986), Baumann and Braga (1988), Faini (1988), and Sonwoo (1989). Overall econometric evidence is mixed and weak.

[4] The term 'policy effectiveness' in this study connotes the case where a certain policy is 'effective' in meeting its designated goals. It does not necessarily mean that the policy is ultimately 'good' for the economy. It is premature to derive any normative conclusion for the evaluation of a certain policy only by examining the fulfillment of its goals. Once we find that a policy is, at least, successful in meeting its goals, then a further examination on the overall effect of the policy with the concept of 'opportunity cost' would be appropriate. In reality, however, it is difficult to get a benchmark to judge a policy. Many policies do not even meet their original goals. Thus, analyzing 'policy effectiveness (as is meant by this study)' itself can be an important beginning step for the full evaluation of a certain policy.

ses of previous research in this area was the limited data set available in their studies. On the impact of export subsidies, most studies have used annual aggregate data on exports, export subsidies, and other variables. The study uses monthly aggregate export subsidy data of Korea for 1981-1992. Third, previous literature shows no consensus in specifying the appropriate structural model for the analysis of export subsidy effects. Theories exist with a wide range of different perspectives from the dependency, neoclassical and Keynesian to the recent new trade school. Previous empirical evidence is also mixed. There is no uniform conclusion that these studies have reached yet. Each of these is accepted conditions under which VAR techniques are indicated. Lastly, the selection of Korea in this study also has economic merits. Korea adopted one of the most comprehensive and active export promotion strategies in economic development history. It would be interesting to see whether an export subsidization policy still works in its export promotion even after a country became a semi-industrialised country. The results of this study will provide some valuable insights into other developing countries regarding the effect, choice, and relevant timing of the export incentive scheme.

Ⅱ. DESCRIPTION OF MODEL

Assume that an export-driven economy can be characterized by:

$$Y_t = F(A_t, X_t) \tag{1}$$

$$A_t = G[a_1(L)X_{t-1}, a_2(L)Y_{t-1}) \tag{2}$$

where Y_t is real output, X_t is real export, and A_t is the measure of knowledge in the economy at period t. In this simple export-led economy, the current level of knowledge is a function of both previous levels of real exports and real output. L is the lag operator and $a(L)$ is a lagged polinomial. $a_1(L)$ in (2) captures the notion of 'dynamic economies' by export activity separating itself from 'output expansion effect'(represented by $a_2(L)$).

Further assume that the current level of export can be determined by the following:

$$X_t = H[b(L)X_{t-1}, c(L)Y_{t-1}, D_t) + \nu_t \tag{3}$$

where $b(L)$ and $c(L)$ are lagged polinomials, D_t is the demand shift variable and ν_t is a white noise random shock. According to equation (3), the current level of export can be influenced by 3 factors: 1) previous levels of export; 2) previous levels of real output; and 3) current demand shift variable. 'Previous levels of real output' can be described as a good proxy for the 'measure of export capacity'. D_t

is the demand shift variable which can be interpreted as a policy response variable by the government, i.e., foreign exchange rate policy and/or export subsidization policy in our model.[5]

$$D_t = S[d(L)Y_{t-1},\ e(L)X_{t-1},\ j(L)D_{t-1}] + \omega_t \tag{4}$$

The policy variable D_t makes a dynamic response to the changes in previous levels of itself and of the real output and real export. Combining equation (1), (2), (3), and (4) generates a four variable VAR model. D is composed of two variables in our model, D_1 and D_2. D_1 and D_2 represent foreign exchange rate policy and export subsidization policy in our model, respectively.

$$Y_t = f[k(L)Y_{t-1},\ l(L)X_{t-1},\ m(L)D_{t-1}] + \rho_t \tag{5}$$

$$X_t = h[n(L)Y_{t-1},\ p(L)X_{t-1},\ q(L)D_{t-1}] + \gamma_t \tag{6}$$

$$D_{1,t} = s_1[r(L)Y_{t-1},\ t(L)X_{t-1},\ u(L)D_{t-1}] + \varepsilon_t \tag{7}$$

$$D_{2,t} = s_2[v(L)Y_{t-1},\ w(L)X_{t-1},\ z(L)D_{t-1}] + \zeta_t \tag{8}$$

As we assume that the exogenous variables have only contemporaneous effects on endogenous variables, the VAR we specify in this study is a 4×8 system with n lags for each endogenous variable:

$$\begin{aligned} EX_t = {} & \sum_i B_{11,i}\, EX_{t-i} + \sum_i B_{12,i}\, XR_{t-i} + \sum_i B_{13,i}\, ST_{t-i} + \sum_i B_{14,i}\, IP_{t-i} \\ & + B_{15}\, FY_t + B_{16}\, XRC_t + B_{17}\, XRJ_t + B_{18}\, XRT_t + e_t \end{aligned} \tag{9}$$

$$\begin{aligned} XR_t = {} & \sum_i B_{21,i}\, EX_{t-i} + \sum_i B_{22,i}\, XR_{t-i} + \sum_i B_{23,i}\, ST_{t-i} + \sum_i B_{24,i}\, IP_{t-i} \\ & + B_{25}\, FY_t + B_{26}\, XRC_t + B_{27}\, XRJ_t + B_{28}\, XRT_t + e_t \end{aligned} \tag{10}$$

$$\begin{aligned} ST_t = {} & \sum_i B_{31,i}\, EX_{t-i} + \sum_i B_{32,i}\, XR_{t-i} + \sum_i B_{33,i}\, ST_{t-i} + \sum_i B_{34,i}\, IP_{t-i} \\ & + B_{35}\, FY_t + B_{36}\, XRC_t + B_{37}\, XRJ_t + B_{38}\, XRT_t + e_t \end{aligned} \tag{11}$$

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[5] Although a wide range of export incentives has been introduced by the Korean government since the early 1960s, the most critical and influential one was 'export financing' (Baumann and Braga 1988, Balassa 1990, World Bank 1993). It is well observed by the existing literature that financial incentives rather than taxational ones have been a significant factor for export growth in Korea.

[Table 1] Definition of Variables

Variable	Definition	Unit
EX	Amount of export in Korea	1985 U.S. million dollar
XR	Nominal exchange rate in Korea	Korean Won / U.S.$
S1	Amount of short-run operational export financing in Korea	1985 U.S. million dollar
S2	Amount of financing for export facility installation in Korea	1985 U.S. million dollar
S3	Amount of long-run export financing in Korea	1985 U.S. million dollar
ST	S1 + S2 + S3	1985 U.S. million dollar
IP	Industrial production index in Korea	1985 = 100
XRC	Nominal exchange rate in China	Chinese Yuan / U.S.$
XRJ	Nominal exchange rate in Japan	Japanese Yen / U.S.$
XRT	Nominal exchange rate in Thailand	Thailand Baht / U.S.$
FY	Weighted average of foreign importers' income based on industrial production index	1985 = 100

$$IP_t = \sum_i B_{41,i} EX_{t-i} + \sum_i B_{42,i} XR_{t-i} + \sum_i B_{43,i} ST_{t-i} + \sum_i B_{44,i} IP_{t-i} + B_{45} FY_t + B_{46} XRC_t + B_{47} XRJ_t + B_{48} XRT_t + e_t \quad (12)$$

Definition of the variables in the model is suggested in [Table 1].[6] I intend to use the following procedures as part of my modeling strategy: First, the VAR technique requires the preliminary exploratory analysis of the data to ensure their stationarity and non-seasonal patterns. The augmented Dickey-Fuller test will be used to examine the stationarity of the data series. The data which show seasonal patterns will be seasonally adjusted by the X11 method. Second, the dynamic responses of each endogenous variable to the changes in variables of interest will

[6] We used nominal exchange rates instead of real exchange rates since the price level of Korean economy in the 1980s was relatively stable compared to those in the 1970s and the 1960s. According to World Bank (1993), the average inflation rates (based on CPI) in Korea during 1961-1991 and 1965-1981 were 12.2% and 15.3% respectively. However, there was a dramatic reduction in inflation in the 1980s. The average inflation rate in Korea during 1982-1991 was 5.2%. We also used the actual amount of 'export financing' as the variable capturing the level of 'export subsidy' since both the curb market interest rates and commercial bank loan interest rates have been stable during the 1980s. The interest rates for 'export financing' have also stayed around 10% during the sample period.

be estimated in the unrestricted form of the VAR model. Both short-run and long-run elasticities will be estimated. I will determine the lag length in our model by using the Akaike Information Criterion. Third, cointegration testing is another important step because the information obtained from this test can be used as restrictions on the unrestricted VAR model. Testing for cointegration is a test for the existence of the long-run equilibrium relationships among variables. Potential long-run hypotheses are suggested later in this paper. For the series to be cointegrated, it is required that: a) the series should be integrated to the same order; b) a linear combination of these series exists which is integrated to a lower order than the individual series (Perman, 1991). Any cointegrated series will imply an error correction mechanism, which is a short-run adjustment process towards an equilibrium. Error correction models can also imply restrictions on the unrestricted VAR models. I will use the maximum-likelihood procedure of Johansen and Jesulius (1990) for the test of multivariate cointegration.

The following hypotheses (H_a) will be examined: 1) Financial export subsidies have long-run positive effects on export growth; 2) Present levels of export subsidies are influenced by past export performances (If government offers subsidies as part of the rewards for the past good export performances, then past export expansions will increase the current levels of export subsidies. If export subsidy policy is directed towards trade balance stabilization, then great past export performances will negatively affect current subsidy levels); 3) The elasticity of exports to the growth of domestic production capacity is positive and significant and there exists a feedback effect between exports and production capacity; 4) Foreign competitors' foreign exchange rate policies have significant impacts on domestic exports; 5) The increases of main importers' income raise the level of exports; and 6) Changes in foreign exchange rates have strong impacts on export performances.

Ⅲ. EMPIRICAL TEST AND ITS RESULTS

3.1 Seasonality and Stationarity

All the variables exhibit no seasonality except EX and S3. EX is the volume of exports and S3 is the amount of long-run export financing. Seasonalities of EX and S3 were smoothed by X11 multiplicative method.[7]

[7] Since the purpose of our study lies in the identification of the dynamic relationships among variables of interest rather than the accurate forecasting of a certain variable, we take the seasonal adjustment procedure for EX and S3. The X11 method is the best-known of these smoothing procedures. It was pioneered by the United States Census Bureau (Shisken, Young, and Musgrave, 1967). For a more detailed discussion of the complexity of the X-11 procedure, see Hylleberg (1986). The complex X-11 method can be approximated very well by much simpler methods based on so called linear filters (Davidson and MacKinnon 1993).

[Table 2] Lag Length and AIC Data in log-level

# of lags	AIC	# of lags	AIC
12	−30.18	6	−30.55
11	−30.22	5	−30.56
10	−30.28	4	−30.69
9	−30.35	3	−30.81
8	−30.53	2	−30.81
7	−30.64	1	−30.45

Stationarity tests of all the variables are an important step in the time series analysis. Augmented Dickey-Fuller unit root tests were applied to all the variables. All the variables in our model are I(1) except XR. XR alone is I(2). This information about the stationarity of the variables along with the cointegration relationship will be used in our final VAR model specification.

3.2 Lag-Length and AIC in the Unrestricted VAR Model[8)]

Since the purpose of this empirical study lies in the examination of the dynamic relationships among variables of interest rather than the accurate forecasting of a certain variable, coefficient estimation of the unrestricted VAR model itself can provide a meaningful derivation of the relationships among variables in level. The choice of the number of lags in the VAR model is important since the performance of the VAR model can be affected by the lag structures. I use the Akaike Information Criterion to determine the number of lags in this study. [Table 2] gives the number of lags and its AIC.

The global minimum AIC was found when the number of lags was 3. A local minimum AIC was found when the number of lags was 7. Contrary to the argument by Hafer and Sheehan (1989), our empirical results showed similar patterns across different lag structures. I found no significant differences in the empirical results between these two alternative models, the VAR model with 7 lags and the VAR model with 3 lags. To prove the consistent patterns of estimation results against different lag structures, both local and global minimum AIC models were estimated and compared.

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[8] Although the main use of the VAR models has been in forecasting, VAR approach has been also known as a good way to estimate dynamic relationships among jointly endogenous variables without imposing a strong priori restrictions. If the objective of VAR approach is for economic forecasting, then the performance of unrestricted VAR models is poor because of the problems of overparameterization and multicollinearity. These problems can be reduced by two alternative methods; first, the Baysian vector autoregression(BVAR) approach of Litterman (1979, 1986) and second, the error correction model (ECM) approach of Davidson et. al. (1978).

[Table 3] Estimated Coefficients of Unrestricted VAR model
Data in log-level, Number of Lags = 7

$$EX_t = B_1 + \sum_i B_{11,i}\, EX_{t-i} + \sum_i B_{12,i}\, XR_{t-i} + \sum_i B_{13,i}\, ST_{t-i} + \sum_i B_{14,i}\, IP_{t-i} + B_{15}\, FY_t + B_{16}\, XRC_t + B_{17}\, XRJ_t + B_{18}\, XRT_t + e_t$$

R-SQUARE = 0.9612 R-SQUARE ADJUSTED = 0.9489

VARIABLE	SUM OF LAG COEFS	STD ERROR	T-RATIO
LEX	0.18250	0.23646	0.77178
LXR	0.15184	0.16428	0.92427
LST	0.16471	0.10117	1.6281
LIP	0.31280	0.21142	1.4796
LFY	1.0660	0.3822	2.789
LXRC	−0.23522	0.1421	−1.655
LXRJ	−0.28068	0.1147	−2.448
LXRT	−0.13436E-01	0.2522	−0.5328E-01
CONSTANT	1.3862	2.265	0.6120

$$XR_t = B_2 + \sum_i B_{21,i}\, EX_{t-i} + \sum_i B_{22,i}\, XR_{t-i} + \sum_i B_{23,i}\, ST_{t-i} + \sum_i B_{24,i}\, IP_{t-i} + B_{25}\, FY_t + B_{26}\, XRC_t + B_{27}\, XRJ_t + B_{28}\, XRT_t + e_t$$

R-SQUARE = 0.9984 R-SQUARE ADJUSTED = 0.9978

VARIABLE	SUM OF LAG COEFS	STD ERROR	T-RATIO
LEX	−0.54281E-01	0.13240E-01	−4.0998
LXR	0.96002	0.91982E-02	104.37
LST	0.91970E-04	0.56644E-02	0.16236E-01
LIP	0.44885E-01	0.11837E-01	3.7918
LFY	0.74565E-02	0.2140E-01	0.3484
LXRC	0.58803E-03	0.7957E-02	0.7390E-01
LXRJ	0.14828E-01	0.6421E-02	2.309
LXRT	0.20173E-01	0.1412E-01	1.429
CONSTANT	0.43480	0.1268	3.429

[Table 3] continued

$$ST_t = B_3 + \sum_i B_{31,i} EX_{t-i} + \sum_i B_{32,i} XR_{t-i} + \sum_i B_{33,i} ST_{t-i} + \sum_i B_{34,i} IP_{t-i} + B_{35} FY_t + B_{36} XRC_t + B_{37} XRJ_t + B_{38} XRT_t + e_t$$

R-SQUARE = 0.9879 R-SQUARE ADJUSTED = 0.9840

VARIABLE	SUM OF LAG COEFS	STD ERROR	T-RATIO
LEX	−0.14249	0.72425E-01	−1.9675
LXR	−0.61646E-02	0.50316E-01	−0.12252
LST	0.91084	0.30986E-01	29.396
LIP	0.30969E-02	0.64753E-01	0.4783E-01
LFY	0.19430	0.1171	1.660
LXRC	0.13630E-01	0.4353E-01	0.3131
LXRJ	−0.89897E-01	0.3512E-01	−2.559
LXRT	0.49808E-01	0.7724E-01	0.6448
CONSTANT	1.6418	0.6937	2.367

$$IP_t = B_4 + \sum_i B_{41,i} EX_{t-i} + \sum_i B_{42,i} XR_{t-i} + \sum_i B_{43,i} ST_{t-i} + \sum_i B_{44,i} IP_{t-i} + B_{45} FY_t + B_{46} XRC_t + B_{47} XRJ_t + B_{48} XRT_t + e_t$$

R-SQUARE = 0.9948 R-SQUARE ADJUSTED = 0.9932

VARIABLE	SUM OF LAG COEFS	STD ERROR	T-RATIO
LEX	−0.54395E-01	0.98075E-01	−0.5546
LXR	0.88465E-01	0.68137E-01	1.2984
LST	0.87559E-01	0.41960E-01	2.0867
LIP	0.93012	0.87687E-01	10.607
LFY	0.20283	0.1585	1.280
LXRC	−0.52338E-0	0.5894E-01	−0.8879E-01
LXRJ	−0.48342E-01	0.4756E-01	−1.016
LXRT	−0.11097	0.1046	−1.061
CONSTANT	−0.73333	0.9394	−0.7806

3.3 Estimated Coefficients of the Unrestricted VAR Model With Local Minimum AIC(= 7 Lags)

Estimated coefficients of the VAR model with local minimum AIC(7 lags) are presented in [Table 3]. The prefix 'L' to the variable in [Table 3] denotes 'log' of the variable. We have 4 endogeneous variables in our model. Each endogeneous variable has its own equation where its current value becomes the dependent variable. Among these 4 equations, our main interest centers on the first one, export equation. All the signs of estimated coefficients in the export equation are as expected. Throughout the 1980s, the volume of exports in Korea(EX) was mainly influenced by external factors, foreign income(FY) and foreign exchange rates of Japan(XRJ) and China(XRC). As the economic conditions of the Korea's major trading partners get better, the volumes of exports in Korea tend to increase. Korean exports are sensitive to the changes of economic situations in 4 major importers, i.e., U.S., Japan, Germany, and England. The short-run and long-run elasticities of exports are shown in [Table 5]. The short-run elasticities of exports are equal to the coefficients of XR_{t-1}, $ST_{t-1}(S1_{t-1}, S2_{t-1}, S3_{t-1})$, IP_{t-1}, FY_t, XRJ_t, and XRT_t (In the case of endogenous variables, the coefficients of the first lagged endogenous variables become the short-run elasticities while the coefficients of contemporaneous exogenous variables become the short-run elasticities for exogenous variables). The long-run elasticities of exports were yielded by assuming the steady state where the lag terms are equally weighted. For example, from the following export equation (13), the long-run export subsidy elasticity of export is calculated by (14).

$$EX_t = \sum_i B_{11,i} EX_{t-i} + \sum_i B_{12,i} XR_{t-i} + \sum_i B_{13,i} ST_{t-i} + \sum_i B_{14,i} IP_{t-i} + B_{15} FY_t + B_{16} XRC_t + B_{17} XRJ_t + B_{18} XRT_t + e_t \quad (13)$$

$$B(L)/A(L) \quad (14)$$

where L is the lag operator and $A(L)$ and $B(L)$ are lagged polinomials for ST and EX. $B(L) = \sum_i B_{13,i}$ ($i = 1, 2, 3, 4, 5, 6,$ and 7) and $A(L) = 1 - \sum_i B_{11,i}$ ($i = 1, 2, 3, 4, 5, 6,$ and 7). The short-run export subsidy elasticity of exports is $B_{13,1}$, which is the coefficient of ST_{t-1}. The standard error of the long-run subsidy elasticity of export was calculated by testing:

$$B(L)/A(L) = 0 \quad (15)$$

Shazam does perform this non-linear test and gives the standard error of the statistic being tested. Since the short-run elasticities in this study show either con-

temporaneous(in the case of exogenous variables) or at most one-month time lag effects among variables, they may not capture the persistent and dynamic effects of the variables on each other. Thus, our interpretation of the empirical results is mainly focused on the long-run elasticities in [Table 5]. It is also as expected that some short-run elasticities are statistically insignificant because of the timing problem. We reported the short-run elasticities in [Table 5] only for the cases where short-run elasticities have some explanatory power.

The foreign income elasticity of exports is 1.066 in the short-run and 1.304 in the long-run. Both short-run and long-run foreign income elasticities are elastic. This result is consistent with the findings of Balassa et al. (1986), World Bank (1987), and Sonwoo (1989) in that these elasticities are elastic. According to Sonwoo (1989), estimated foreign income elasticity of export in Korea during 1965-1986 was 1.314. Kwack (1985), Kwack and Mered (1980), and Y. B. Kim (1984) showed that foreign income elasticity of exports in Korea was about 6 during 1962-1978 and about 4 during 1974-1984. Balassa et al. (1986) found that output elasticity of export in Korea during 1965-1979 was about 3. Our estimated coefficients suggest that the average 10% increases of the industrial productions in these 4 countries do improve the export performances in Korea by 11% in the short-run and 13% in the long-run.[9] [Table 9] summarizes different estimates of elasticities of exports.

As foreign competitors' currencies are devaluated or depreciated against dollar, the exports in Korea decline in their volumes. The coefficients of these foreign competitors' foreign exchange rates are negative in all cases and significant in the cases of China(XRC) and Japan(XRJ). These estimated coefficients in [Table 3] confirm the fact that the devaluation(or depreciation) of foreign competitors' currencies makes domestic exportables relatively more expensive in the international market and thus lets the competitiveness of domestic exportables erode. These cross elasticities of export demand in Korea are presented in [Table 5]. In the case of Chinese Yuan, the short-run and long-run elasticities are -0.235 and -0.287 respectively. -0.281 and -0.344 are the elasticities of Korean exports towards the changes of the values of Japanese Yen. This implies that if Japanese Yen depreciates by 10%, then the exports in Korea decrease by 3% approximately both in the short-run and long-run. This result is consistent with the find

[9] The rapid increase in Korean exports in the 1980s was mostly due to the surge in the U.S. and Japanese imports. From 1981 to 1988, Korean exports increased by $28.5 billion. Of this increment, 55% went to the U.S. and 30% to Japan. Another important factor in the rise of Korean exports in the 1980s was U.S. restrictions on imports from Japan, which diverted some U.S. imports from Japan to Korea. These developments were especially favorable to the exports of passenger cars, electronic goods, and metal products. Our regression results provide the empirical confirmation of the argument by Rhee (1990) and Corbo and Suh (1992) that the economic growth of Korea in the 1980s were largely influenced by external factors.

[Table 4] Estimated Coefficients of Unrestricted VAR model
S1, S2, S3 all included Data in log-level, Number of Lags = 7

$$EX_t = B_1 + \sum_i B_{11,i}\, EX_{t-i} + \sum_i B_{12,i}\, XR_{t-i} + \sum_i B_{13,i}\, S1_{t-i} + \sum_i B_{14,i}\, S2_{t-i} + B_{15,i}\, S3_{t-i} + B_{16,i}\, IP_{t-i} + B_{17}\, FY_t + B_{18}\, XRC_t + B_{19}\, XRJ_t + B_{10}\, XRT_t + e_t$$

R-SQUARE = 0.9715 R-SQUARE ADJUSTED = 0.9564

VARIABLE	SUM OF LAG COEFS	STD ERROR	T-RATIO
LEX	−0.36846E-01	0.23765	−0.1550
LXR	0.49959E-01	0.21598	0.23131
LS1	0.10233	0.67698E-01	1.5116
LS2	0.98316E-01	0.48304E-01	2.0354
LS3	0.31491E-01	0.53853E-01	0.58476
LIP	0.93901E-01	0.30639	0.30647
LFY	1.9211	0.4927	3.899
LXRC	−0.31538	0.1503	−2.098
LXRJ	−0.34111	0.2112	−1.615
LXRT	−0.12686E-01	0.2642	−0.4801E-01
CONSTANT	1.5994	2.390	0.6693

$$IP_t = B_4 + \sum_i B_{41,i}\, EX_{t-i} + \sum_i B_{42,i}\, XR_{t-i} + \sum_i B_{43,i}\, S1_{t-i} + \sum_i B_{44,i}\, S2_{t-i} + B_{45,i}\, S3_{t-i} + B_{46,i}\, IP_{t-i} + B_{47}\, FY_t + B_{48}\, XRC_t + B_{49}\, XRJ_t + B_{40}\, XRT_t + e_t$$

R-SQUARE = 0.9965 R-SQUARE ADJUSTED = 0.9946

VARIABLE	SUM OF LAG COEFS	STD ERROR	T-RATIO
LEX	−0.14718	0.94791E-01	−1.5527
LXR	0.50006E-01	0.86150E-01	0.58045
LS1	0.36177E-01	0.27003E-01	1.3397
LS2	0.55267E-01	0.19267E-01	2.8685
LS3	0.36983E-01	0.21481E-01	1.7217
LIP	0.83183	0.12221	6.8064
LFY	0.53058	0.1965	2.700
LXRC	−0.57269E-01	0.5996E-01	−0.9552
LXRJ	−0.71489E-01	0.8426E-01	−0.8485
LXRT	−0.72537E-01	0.1054	−0.6882
CONSTANT	−0.58432	0.9532	−0.6130

ing of Sonwoo (1989). Sonwoo (1989)'s estimated Japanese Yen elasticity of Korean exports during 1965-1986 was −0.393 and statistically significant.

Although there exists pessimism about how long the effect will last, economic theory tells us that the balance of payments improves for the devaluing country. In the case of Korea, the devaluation of Korean Won per dollar has a positive but statistically insignificant effect on the volume of exports in the long-run. Sonwoo (1989)'s estimated export price elasticity of exports in Korea during 1965-1986 was 0.155 and statistically insignificant([Table 9]), which is similar to our result in [Table 5].

Exports are expected to grow as increased export capacities(IP for proxy) can meet the growing export demands. In our regression estimation, the long-run capacity elasticity of export is positive and statistically significant in the long-run but positive and statistically insignificant in the short-run. As export capacity increases by 100% in Korea, 38% increment of exports is expected in the long-run.

Export subsidies in Korea played an important role in the promotion of exports. The short-run and long-run export subsidy elasticities of exports are 0.106 and 0.202. The short-run export subsidy elasticity of export is positive but statistically insignificant. This statistically insignificant short-run elasticity explains the fact that one month period is not long enough to expect any significant influence of export subsidies on exports. In the long-run, however, the elasticity is statistically significant. A 10% increase of export financing can bring in about 2% growth of exports. Sonwoo(1989)'s estimated export subsidy elasticity of exports in Korea during 1965-1986 was 0.118 and statistically significant, which is also similar to our result in [Table 5].

Different types of export subsidies can have different impacts on the export performance. The upper part of [Table 4] presents the estimated coefficients of these 3 types of export subsidies, S1, S2, and S3. All the signs of the estimated coefficients of S1, S2, S3 are positive. S2 elasticities of exports in both short-run and long-run are approximately 0.1. Among these 3 types of subsidies, the influence of export facility installation financing on exports stands out. A 100% increase of S2 brings in 10% growth of exports in the long-run. Although the S2 elasticity of exports is inelastic, its long-run effect on exports is still positive and statistically significant.

S2 seems to be effective in the promotion of exports in the long-run for four reasons: 1) S2 is directly related to export capacity upgrading. It offers a direct incentive to purchase capital goods required for exporting. The upgrading of export facilities can have a positive impact on export competitiveness. 2) S2 is provided only for the firms which are efficient and confident enough to utilize the new facility and finally export more than 50% of the loan amount they received. Companies are obliged to keep the terms of loans, part of which is exporting. The Korean government rewarded successful firms with continued credit support

[Table 5] Short Run and Long Run Elasticities
Data in log-level, Number of Lags = 7

Dependent Variable	Independent Variable	Elasticity	
		Short Run (T stst.)	Long Run (T stst.)
Export	XR		0.186 (0.796)
	ST	0.103 (0.342)	0.202 (1.615)
	S1		0.098 (1.441)
	S2	0.132 (0.943)	0.095 (2.111)
	S3		0.030 (0.584)
	IPI		0.382 (1.728)
	FY	1.066 (2.789)	1.304 (3.326)
	XRC	−0.235 (−1.655)	−0.287 (−1.651)
	XRJ	−0.281 (−2.448)	−0.344 (−2.351)
	XRT		−0.016 (−0.053)
Industrial Production	XR		1.257 (0.738)
	ST	0.910 (1.470)	1.257 (0.689)
	S1		0.212 (0.977)
	S2	0.132 (2.365)	0.324 (1.208)
	S3		0.218 (1.450)
	FY	0.203 (1.280)	2.900 (0.740)
	XRC		−0.071 (−0.821)
	XRJ	−0.048(−1.016)	−0.686 (−0.667)
	XRT	−0.111(−1.061)	−1.586 (−0.878)
Foreign Exchange Rate	EX	−0.008 (−1.337)	−1.350 (−4.289)
	IPI		1.125 (3.136)
	XRC		0.025 (0.074)
	XRJ	0.015 (2.309)	0.375 (2.088)
	XRT	0.020 (1.429)	0.500 (1.566)
Subsidy Total	EX		−1.570 (−1.481)
	FY	0.194 (1.660)	2.155 (1.338)
	XRJ	−0.090 (−2.559)	−1.000 (−2.134)

while reducing export credit to less successful firms(World Bank 1993). Companies that failed to meet this export criterion could be driven into bankruptcy. 3) As a firm becomes successful in exporting its products, it gets more benefits in the near future from the government. It can get more export facility financing(up to a 100%) as government acknowledges its previous export performances by the records. 4) Specific export target as well as easy monitoring in the provision of S2 seems to contribute to its strong influence on the expansion of export and

output. In the case of S1, government imposed tight restrictions on the qualification of the financing beneficiaries based on the size of the firm. As long as a company has a compatible amount of its own asset to the loan amount, it can apply for the loans regardless of its potential exportability. In other words, to be considered as a qualified applicant for S1, the asset value of a company should be at least equal to the loan amount it applies for. S1 represents loans for transactional purposes for firms to buy inputs and make arrangements for exporting. As is the case in Brazil (Baumann and Braga 1988), timing between financing and exporting can be mismatched. S3 is provided only to the ship-building industry and its amount is negligible. Further, S3 does not entail any obligation for firms to export their products.

The second equation in [Table 3] explains the determinants of foreign exchange rates in Korea. Foreign exchange rates of Korean Won respond positively to the changes of those of Japanese Yen, Chinese Yuan, and Thai's Baht. The depreciations of Japanese Yen have significantly contributed to the devaluations of Korean Won. In the short-run, the Yen elasticity of Won is only 0.015. The long-run Yen elasticity of Won is 0.375. The priority of the foreign exchange rate policy in Korea seems to be given to the stabilization of the volume of exports. The negative and significant effects of previous export performances on current foreign exchange rates suggest that the devaluations of the Korean Won are widely used to offset the trade deficit problem. This is also true for the case of export subsidies. The results of the subsidy equation in [Table 3] show that export subsidies are also directed towards the stabilization of the exports. Increased domestic incomes(IP for proxy) can stimulate the importation of foreign products, which can increase the trade deficit problem, too. Thus, devaluation of Korean Won against dollar can be again useful to increase export, which can possibly avoid the trade deficit. We can find this evidence in the second equation of [Table 3].

Export subsidies can increase the levels of domestic industrial productions. The impact of export subsidies on domestic production is positive but statistically insignificant. This is presented in the last equation of [Table 3]. In the long-run, the subsidy elasticity of industrial production is 1.257. Among 3 types of export subsidies, S2 is a significant contributing factor to the growth of industrial production in Korea. This is shown in the second equation of [Table 4] and [Table 5]. Once S1, S2, and S3 are all included in the IP regression, the effect of foreign income changes on the domestic production condition also gets stronger.

The devaluations of Korean Won may help to increase domestic production while those of foreign competitors' currencies can decrease them. If devaluation is to improve the trade balance, it also increases the difference between income and expenditure. The positive sign of XR and negative signs of XRC, XRJ, XRT in the last equation of [Table 3] are as expected even though the estimated coefficients are statistically insignificant.

3.4 Estimated Coefficients of the Unrestricted VAR Model With Global Minimum AIC(3 Lags)

Estimated coefficients of the VAR model with global minimum AIC(3 lags) are presented in [Table 6]. All the signs of estimated coefficients in export equation are as expected. Again, the volume of exports in Korea(EX) are mainly affected by external factors, foreign income(FY) and foreign exchange rates of Japan(XRJ) and China(XRC). As the weighted average income of the Korea's major trading partners gets higher, the volumes of exports in Korea increase. Korean exports sensitively respond to the changes of economic situations in its major trading partners.

The short-run and long-run elasticities of exports are shown in [Table 8]. The foreign income elasticity of exports is 0.918 in the short-run and 1.280 in the long-run. The long-run foreign income elasticity of export is elastic. These estimated coefficients suggest that the average 10% increases of the industrial productions in these 4 countries improve the export performances in Korea by 9% in the short-run and 13% in the long-run.

As foreign competitors' currencies are devaluated (or depreciated) against dollar, the exports in Korea decline in their volumes. The coefficients of these foreign competitors' foreign exchange rates are negative in all cases and significant in the cases of China(XRC) and Japan(XRJ). These estimated coefficients in [Table 6] confirm the fact that the devaluation (or depreciation) of foreign competitors' currencies does make domestic exportables relatively more expensive in the international market and thus let the competitiveness of domestic exportables fall. These cross elasticities of export demand in Korea are presented in [Table 8]. In the case of Chinese Yuan, the short-run and long-run elasticities are -0.322 and -0.449 respectively. -0.364 and -0.508 are the elasticities of Korean exports towards the changes of the values of Japanese Yen. This implies that if Japanese Yen depreciates by 10%, then the exports in Korea decrease by 4% in the short-run and 5% in the long-run. The devaluation of Korean Won against dollar has a positive but statistically insignificant effect on the volume of exports.

Exports are expected to grow as increased export capacities(IP for proxy) can meet the growing export demands. In our regression estimation, the coefficient is positive and statistically significant in the long-run.

Export subsidies in Korea have a positive impact on the promotion of exports. The long-run export subsidy elasticity of export is 0.151. 10% increase of export financing can bring in about 1.5% growth of exports in the long-run. The upper part of [Table 7] presents the estimated coefficients of these 3 types of export subsidies, S1, S2, and S3. Among these 3 types of subsidies, only the influence of export facility installation financing on exports is positive. The S2 elasticity of exports is 0.034 in the long-run.

The second equation in [Table 6] explains the determinants of foreign exchan-

[Table 6] Estimated Coefficients of Unrestricted VAR model
Data in log-level, Number of Lags = 3

$$EX_t = B_1 + \Sigma B_{11,i} EX_{t-i} + \Sigma B_{12,i} XR_{t-i} + \Sigma B_{13,i} S_{t-i} + \Sigma B_{14,i} IP_{t-i} + B_{15} FY_t + B_{16} XRC_t + B_{17} XRJ_t + B_{18} XRT_T + e_t$$

R-SQUARE = 0.9563 R-ADJUSTED = 0.9506

VARIABLE	SUM OF LAG COEFS	STD ERROR	T-RATIO
LEX	0.28327	0.14174	1.9986
LXR	0.15150	0.11945	1.2683
LST	0.10800	0.77322E-01	1.3968
LIP	0.32831	0.14208	2.3107
LFY	0.91811	0.3033	3.027
LXRC	−0.32202	0.1080	−2.982
LXRJ	−0.36356	0.9982E-01	−3.642
LXRT	−0.14475	0.1970	0.7347
CONSTANT	1.4520	1.673	0.8678

$$XR_t = B_2 + \Sigma B_{21,i} EX_{t-i} + \Sigma B_{22,i} XR_{t-i} + \Sigma B_{23,i} ST_{t-i} + \Sigma B_{24,i} IP_{t-i} + B_{25} FY_t + B_{26,i} XRC_t + B_{27} XRJ_t + B_{28} XRT_t + e_t$$

R-SQUARE = 0.9978 R-ADJUSTED = 0.9975

VARIABLE	SUM OF LAG COEFS	STD ERROR	T-RATIO
LEX	−0.21643E-01	0.87564E-02	−2.4717
LXR	0.96970	0.73793E-02	131.41
LST	−0.51809E-03	0.47769E-02	−0.10846
LIP	0.11596E-01	0.87778-02	1.3210
LFY	0.61921E-02	0.1874E-01	0.3304
LXRC	0.12741E-01	0.6670E-02	1.910
LXRJ	0.17744E-01	0.6167E-02	2.877
LXRT	−0.23175E-02	0.1217E-01	−0.1904
CONSTANT	0.24637	0.1034	2.383

[Table 6] continued

$$ST_t = B_3 + \Sigma B_{31,i} EX_{t-i} + \Sigma B_{32,i} XR_{t-i} + \Sigma B_{33,i} ST_{t-i} + \Sigma B_{34,i} IP_{t-i} + B_{35} FY_t + B_{36,i} XRC_t + B_{37} XRJ_t + B_{38} XRT_T + e_t$$

R-SQUARE = 0.9856 R-ADJUSTED = 0.9837

VARIABLE	SUM OF LAG COEFS	STD ERROR	T-RATIO
LEX	−0.57150E-01	0.44803E-01	−1.2756
LXR	0.36535E-01	0.37757E-01	0.96764
LST	0.93217	0.24442E-01	38.138
LIP	−0.64738E-01	0.44913E-01	−1.4414
LFY	0.18917	0.9589E-01	1.973
LXRC	0.12935E-01	0.3413E-01	0.3790
LXRJ	−0.88835E-01	0.31553−01	−2.815
LXRT	0.29090E-01	0.6228E-01	0.4671
CONSTANT	0.70521	0.5289	1.333

$$IP_t = B_4 + \Sigma B_{41,i} EX_{t-i} + \Sigma B_{42,i} XR_{t-i} + \Sigma B_{43,i} ST_{t-i} + \Sigma B_{44,i} IP_{t-i} + B_{45} FY_t + B_{46,i} XRC_t + B_{47} XRJ_t + B_{48} XRT_t + e_t$$

R-SQUARE = 0.9944 R-ADJUSTED = 0.9937

VARIABLE	SUM OF LAG COEFS	STD ERROR	T-RATIO
LEX	−0.71474E-02	0.58796E-01	−0.12156
LXR	0.61910E-01	0.49549E-01	1.2495
LST	0.44943E-01	0.32075E-01	1.4012
LIP	0.92165	0.58940E-01	15.637
LFY	0.13079	0.1258	1.039
LXRC	−0.65818E-03	0.4479E-01	−0.1470E-01
LXRJ	−0.48838E-01	0.4141E-01	−1.179
LXRT	−0.44892E-01	0.8173-01	−0.5493
CONSTANT	−0.53524	0.9641	−0.7712

ge rates in Korea. Foreign exchange rates of Korean Won respond positively to the changes of those of Japanese Yen, Chinese Yuan. The estimated coefficients of Japanese Yen and Chinese Yuan are both positive and statistically significant. The depreciations of Japanese Yen have significantly contributed to the devaluations of Korean Won. In the short-run, the Yen elasticity of Wion is 0.018 and

[Table 7] Estimated Coefficients of Unrestricted VAR model
S1, S2, S3 all included Data in log-level, Number of Lags = 3

$$EX_t = B_1 + \Sigma B_{11,i} EX_{t-i} + \Sigma B_{12,i} XR_{t-i} + \Sigma B_{13,i} S1_{t-i} + \Sigma B_{14,i} S2_{t-i} + B_{15} S3_{t-i} + B_{16} IP_{t-i} + B_{17} FY_t + B_{18} XRJ_t + B_{10} XRT_T + e_t$$

R-SQUARE = 0.9584 R-ADJUSTED = 0.9505

VARIABLE	SUM OF LAG COEFS	STD ERROR	T-RATIO
LEX	0.25259	0.14533	1.7380
LXR	0.31461	0.16966	1.8543
LS1	−0.43447E-01	0.53213E-01	−0.81649
LS2	0.25349E-01	0.23215E-01	1.0910
LS3	−0.30180E-01	0.25056E-01	−1.2045
LIP	0.20527	0.17632	1.1642
LFY	1.0243	0.3502	2.925
LXRC	−0.26094	0.1118	−2.334
LXRJ	−0.36300	0.1072	−3.385
LXRT	−0.33955E-01	0.2505	−0.1356
CONSTANT	2.4904	1.654	1.505

$$IP_t = B_4 + \Sigma B_{41,i} EX_{t-i} + \Sigma B_{42,i} XR_{t-i} + \Sigma B_{43,i} S1_{t-i} + \Sigma B_{44,i} S2_{t-i} + B_{45} S3_{t-i} + B_{46,i} IP_{t-1} + B_{47} FY_t + B_{48} XRC_t + B_{49} XRJ_t + B_{40} XRT_t + e_t$$

R-SQUARE = 0.9951 R-ADJUSTED = 0.9941

VARIABLE	SUM OF LAG COEFS	STD ERROR	T-RATIO
LEX	−0.20020E-01	0.57863E-01	−0.34599
LXR	0.13119	0.67547E-01	1.9422
LS1	−0.14316E-01	0.21186E-01	−0.67571
LS2	0.23986E-01	0.92426E-02	2.5951
LS3	0.15561E-01	0.99758E-02	1.5599
LIP	0.79188	0.70199E-01	11.280
LFY	0.30860	0.1394	2.213
LXRC	0.14584E-01	0.4452E-01	0.3276
LXRJ	−0.72214E-01	0.4269E-01	−1.691
LXRT	−0.11688	0.9972E-01	−1.172
CONSTANT	−0.46033	0.6586	0.6989

[Table 8] Short Run and Long Run Elasticities
Data in log-level Number of Lags = 3

Dependent Variable	Independent Variables	Elasticity	
		Short Run (T stst.)	Long Run (T stst.)
Export	XR		0.211 (1.169)
	ST		0.151 (1.425)
	S1		−0.058 (−0.816)
	S2	0.082 (0.799)	0.034 (1.079)
	S3	−0.019 (−1.249)	−0.040 (−1.195)
	IPI		0.457 (2.590)
	FY	0.918 (3.027)	1.280 (3.612)
	XRC	−0.322 (−2.982)	−0.449 (−2.995)
	XRJ	−0.364 (−3.642)	−0.508 (−3.555)
	XRT		−0.202 (−0.736)
Industrial Production	XR		0.774 (0.948)
	ST	0.116 (1.038)	0.562 (0.892)
	S1		−0.068 (−0.702)
	S2	0.046 (1.116)	0.114 (2.660)
	S3	0.007 (1.116)	0.074 (1.635)
	FY	0.131 (1.039)	1.635 (0.910)
	XRC		−0.008 (−0.958)
	XRJ	−0.049 (−1.179)	−0.610 (−0.958)
	XRT		−0.561 (−0.565)
Foreign Exchange Rate	EX	−0.009 (−1.590)	−0.713 (−2.371)
	IPI		0.383 (1.287)
	XRC	0.013 (1.910)	0.420 (1.972)
	XRJ	0.018 (2.877)	0.584 (2.596)
	XRT		0.076 (−0.187)
Subsidy Total	EX		−0.816 (−1.077)
	FY	0.189 (1.973)	2.702 (1.471)
	XRJ	−0.089 (−2.815)	−1.262 (−2.404)

the Yuan elasticity of Won is 0.013. In the long-run, the Yen elasticity of Won is 0.584 and the Yuan elasticity of Won is 0.420.

The stabilization of the volume of exports seems to be the main target of the foreign exchange rate policy in Korea. The negative and significant effects of previous export performance on current foreign exchange rates suggest that the devaluations of the Korean Won are widely used to offset the trade deficit problem. Increased domestic income(IP for proxy) can stimulate the importation of

[Table 9] Elasticities(η) of Exports

Study	Foreign Income η of Exports	Export Subsidy η of Exports	Export Price η of Exports
Somwoo*	1.314(2.116) (1965~1986)	0.118(3.137) (1965~1986)	0.155(0.832) (1965~1986)
	2.138(2.552) (1977~1986)	0.111(2.486) (1977~1986)	−0.443(−1.228) (1977~1986)
World Bank** (1987)	5.5 to 6.4 (1962~1978)		1.4 to 3.2 (1962~1984)
	3.5 to 4.3 (1974~1984)		1.4 to 1.7 (1974~1984)
Balassa*** (1986)	A. 2.7 to 3.4 (1965~1979)		1.50 to 1.53 (1965~1979)
	B. 2.7 to 3.5 (1965~1979)		1.9 to 2.4 (1965~1979)
This Study† (1994)	A. 1.304(3.326)	0.202(1.615)	0.186(0.796)
	B. 1.280(3.612)	0.151(1.425)	0.211(1.169)

* Estimated coefficient of 'financial incentive' was used to calculate export subsidy elasticity of export in Sonwoo(1989)'s study.

** World Bank (1987) estimates are based on Kwack (1985), Kwack and Mered (1980), and Y. B. Kim (1984).

*** Balassa A. based on OLS estimation and B. on TSLS estimation

† This study A. based on 7 lags and B. on 3 lags. Subsidy total (ST) was used to calculate export subsidy elasticity of export in this table.

foreign products, which can cause the trade deficit problem, too. Thus, devaluation can be again useful to avoid the trade deficit when imports increase. We can find this evidence in the second equation of [Table 6].

Export subsidies can increase the levels of domestic industrial productions. The impact of export subsidies on domestic productions is positive but statistically insignificant. This is presented in the last equation of [Table 6]. In the long-run, the subsidy elasticity of industrial production is 0.562. Among 3 types of export subsidies, S2 and S3 proved to be contributing to the growth of industrial production in the long-run in Korea. This is shown in the second equation of [Table 7] and [Table 8]. The estimated coefficient of S2 is positive and statistically significant. Once S1, S2, and S3 are all included in the IP regression, the estimated coefficient of foreign income, which captures the foreign income elasticity of domestic production, gets positive and statistically significant.

The devaluations of Korean Won may help increase domestic production while those of foreign competitors' currencies can lower them. The positive sign of XR and negative signs of XRC, XRJ, XRT in the last equation of [Table 6] are as expected even though the estimated coefficients are statistically insignificant.

3.5 Existence of Cointegration and Error Correction Mechanism

The cointegration relationship can be interpreted as the long-run relationship between the levels of variables.[10] The Johansen procedure (Johansen and Juselius, 1990) is useful to test the existence of these long-run relationships between variables of interest. Once we find the existence of the equilibrium relationships by the rank tests, we can use this information to examine the short-run adjustment processes of the variables. The deviations of the variables from the long-run equilibrium relationships provide additional information we can use in our regression analysis. The residuals in the cointegration relationships are the error correction components in the model.

When the variables are cointegrated, the estimates of the long-run equilibrium parameters are consistent and highly efficient (Perman, 1991). The test results show that we have only 1 cointegrating relationship between exports, export subsidies, foreign exchange rates, and industrial production. Based on the MAXEIG statistic(40.081) when $R = 0$, we can reject the null hypothesis($R = 0$) that there is no cointegrating relationship among the variables we consider. Based on the MAXEIG statistic(20.968) when $R = 1$, we can not reject the null hypothesis that there exists one cointegrating relationship among the variables.

I examined and confirmed the existence of the cointegrating relationship be-

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[10] It is possible for two or more variables to be I(1) and yet for certain linear combinations of those variables to be I(0). If that is the case, the variables are said to be cointegrated. Engle and Granger (1987) used OLS to estimate a cointegrating vector. The coefficient on Y_t were normalized to unity and the regression we run is; $Y_t = BX_t + U_t \cdots (1)$. The problems with running regression (1) include; first, if Y and X are cointegrated, they are determined jointly, which implies the error term will be correlated with the regressors and second, regressing a variable which is I(1) on another I(1) variable can cause a spurious regression problem (Maddala, 1992). However, if Y_t and X_t are in fact cointegrated, the OLS estimates from the above regression equation will be consistent and highly efficient (Stock, 1987, Davidson and MacKinnon, 1993). The most popular tests for cointegration whether two or more variables are cointegrated were suggested by Engle and Granger (1987). The augmented Engle-Granger test(AEG test) is the ADF test on the residuals. If Y_t and X_t are cointegrated, the true equilibrium error term U_t must be I(0). Thus, AEG test involves estimating the cointegration regression(a static regression with no lags) and then using ADF test on the error term. The null hypotheses is that U has a unit root(or Y and X are not cointegrated) and the alternative one is that Y and X are cointegrated. The estimated coefficients from the cointegration regression can be used to analyze short-run dynamics.

tween exports, export subsidies, foreign exchange rates, and industrial productions. I use the empirical results from the previous estimation of the unrestricted VAR model for the derivation of the cointegrating vector in the VAR model. The long-run elasticities we derived from the estimation of the unrestricted VAR model with global minimum AIC(= 3 lags) in [Table 8] will be used to calculate the cointegrating coefficients.

From the estimated coefficients of the unrestricted VAR model with 3 lags, the long-run elasticities of exports are presented in [Table 8]. Using this information, the cointegrating vector in our model can be derived as (1 −0.211 −0.151 −0.457).

Basically what we do here is to capture the long-run relationship between variables of interest and use that information in our estimation of the final VAR model where all the variables are transformed to be stationary. If there is a stable long-run relationship between variables, the residuals from the cointegration regression should be stationary. Thus, the stationarity of the residuals was tested by the augmented Dickey-Fuller test. The residuals were calculated from the cointegration regression where the cointegrating vector is composed of the long-run elasticities of exports.

The error correction component in our model is actually trend-stationary even though non-trended data seemingly has a unit root. Hence, the short-run deviations can be used as an additional information in the VAR model.

Previous test results show that all the variables in our model except XR(foreign exchange rates of Korean Won) are I(1). The nonstationary characteristics of the variables in our model makes it necessary to transform these nonstationary data into stationary ones in the final VAR model. I used the differencing of the data for the stationarity transformation. The estimated coefficients of error correction components C1, C2, C3, and C4 are −0.218, −0.019, −0.032, and −0.024 respectively. The signs of these coefficients are as expected, which reveals the existence of the error correction mechanisms in these variables, and all of these coefficients are statistically significant.

Ⅳ. SUMMARY AND CONCLUSION

In this paper, I examined the interactive dynamics between exports, export subsidies, foreign exchange rates, and industrial production in Korea. The steps I took are summarized as follows:

1) I investigated the stationarity of the data by the ADF test. Two data series, which show seasonalities, were adjusted by the X11 method.

2) The number of lags in the unrestricted VAR model was determined by the AIC. The coefficients of the unrestricted VAR model in log-level were estimated.

3) The short-run and long-run elasticities from the empirical results of the unrestricted VAR model were calculated and interpreted.

4) I performed the cointegration rank test using the Johansen procedure and confirmed the existence of the long-run relationship among the variables of interest.

5) I used the estimated long-run elasticities between the levels of the variables in the unrestricted VAR model and calculated the error correction component.

6) I incorporated this long-run relatonship into the VAR model and estimated the coefficients.

The findings on the interactive dynamic relations among the variables of interest are as follows:

1) Export subsidies, more specifically export facility installation financing(S2), have contributed significantly to the growth of exports in Korea during 1981-1992. Such effect is not found to be significant on exports in the other two types of financial incentives, S1 and S3. Export subsidies as a group(ST) have a positive impact on the growth of exports in Korea.

2) For the impact of foreign competitors' exchange rate policies on exports in Korea, our analysis provides some meaningful results. The depreciation(or devaluation) of Japanese Yen and/or Chinese Yuan has been detrimental to the export growth in Korea.

3) The growth of income in major trading partners has a positive and significant effect on the promotion of exports in Korea. The elasticity of exports with respect to foreign income is unitary in Korea during 1981-1992. Along with the influence of Yen and Yuan on exports and industrial production in Korea, the study can tentatively conclude that the economic growth of Korea in the 1980s was mainly contributed by external factors. In other words, Korean economy in the 1980s was quite vulnerable to the offshore external shocks.

4) The evidence suggests that export subsidies in Korea are used to stabilize exports. This is also true for the objective of foreign exchange rate policy in Korea. Trade balance stabilization takes priority in foreign exchange rate policy of the Korean government.

5) Foreign exchange rates in Korea have been influenced by those of Japan. The dollar values of Korean Won respond sensitively to the dollar value changes of Japanese Yen.

6) Export subsidies, more specifically export facility installation financing(S2) and long-run export financing(S3), have positively contributed to the industrial production in Korea. Higher foreign income(FY) also helped to increase the industrial production in Korea.

7) Export subsidies have had a significant short-run adjustment mechanism towards its long-run equilibrium path.

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