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Economic and Political Changes and Import Demand Behavior of North Korea

Kang-Taeg Lim and Jae-Young Kim*

We study some empirical aspects of North Korean economy implied in its import behavior in the period before the collapse of Soviet Union. Our analysis is based on econometric inference for a cointegration relation and some model determination methods. We have found that for North Korean economy some non-market factors are important determinants of the import behavior. The non-market factors are related to the country's political situations, its political relation with two communist superpowers, and its relation with western industrialized countries. Our results show that the non-market factors have different impacts on imports from different countries and imports for different commodity groups, which enables us to find some interesting aspects of North Korean economy. Among several results those with the following two implications are of particular interests. First, the two communist superpowers were overall stable and the most important suppliers to North Korean economy regardless of the political situation while Western countries filled the deficiency, if any, caused by Sino-Soviet dispute. Second, the foreign debt problem had significantly negative impacts on imports from the capitalist countries, which is true even after the new open door policy initiated in 1984.

I. Introduction

North Korean economy is characterized by the following two facts: First, the door has been firmly closed throughout. Second, the central government controls almost every part of the economy. Because the door has been closed throughout and also because data have not been made public in North Korea (NK), only very limited information about the economy is available. The behavior of NK's imports is one of a few sources of information on the economy for which data are available from trading partners. In this paper, we study empirical behavior of North Korean imports to find what are practically important factors determining the level of imports of the country.

In economics we usually assume that the national income and relative prices are the main determinants of the level of imports. In the case of NK, however, we might need to consider additional factors for explaining the behavior of imports, in particular, some non-market political factors. Planners in Pyongyang control imports in order to advance

* Korea Institute for National Unification, SL Tobong P.O.Box 22, Seoul, Korea, E-mail: ktlim@ku.kinu.or.kr, Fax: 82-2-901-2542 and Department of Economics, State University of New York at Albany and School of Economics, Seoul National University, respectively. The authors would like to thank Professors Pong Lee and Kajal Lahiri for guidance and helpful suggestions. Thanks also go to Professor Kookshin Ahn and a referee for helpful comments.

friendship and political relationship with foreign countries as well as for economic reasons. In this paper we consider several non-economic factors such as the relationship between China and the former USSR, the foreign debt problem of North Korea since 1970's and changes of the NK's open-door policy.

Political conflict between China and the former USSR, which is called 'Sino-Soviet dispute', often got NK into trouble of deciding which side to be closer to. Sometimes, however, the dispute could be a chance for NK for dealing with the two super-powers in order to get better supports of them.[1] On the other hand, it is well known that the North Korean economy has been suffering from foreign debt problems since the mid-1970s. Because of the inability of paying back its foreign debts North Korea lost its credit, which causes difficulty in obtaining loans from the non-communist countries. As a consequence, the country could not have enough fund to finance imports of physical capital and technology from western countries. To solve this difficulty, the planners decided to attract direct foreign investment in 1984, which is called 'the Joint Venture Law.' However, this new policy did not seem to work well.

The following two results among others are of particular interest in this paper. First, Sino-Soviet dispute did not have a significant impact on imports from the two communist superpowers and also for such commodity groups as manufactured goods and machinery. This implies that the two communist superpowers were overall stable suppliers to North Korean economy. At the same time, however, Sino-Soviet dispute did have significant impacts on imports from western industrialized countries, especially imports from developing countries. Also, Sino-Soviet dispute had significant impacts on imports of such commodity groups as food, live animals, beverages and tobacco. An implication of this result is that the items imported from the two communist superpowers were different, and Sino-Soviet dispute might have impacts on imports of certain items. Then, Western industrialized countries filled the deficiency, if any, caused by Sino-Soviet dispute. Second, the foreign debt problem had significantly negative impacts on imports from the capitalist countries for most commodity groups, which is true even after the new open door policy initiated by the Joint Venture Law of 1984. This implies that the lost credit caused by the accumulated foreign debts damaged the economic relationships between North Korea and the capitalist countries and that the damaged relationships were not improved by the new open door policy.

Our analysis in this paper goes as follows. We first choose the most appropriate model for North Korean import behavior out of several alternatives. Next, based on the chosen model we investigate which factors are important determinants of North Korea's imports. To find the most appropriate model we follow the following steps of model determination: First, for several models under study we apply tests for cointegration to check whether the relationships in the models are economically meaningful. Second, we apply model selection criteria such as Bayesian information criterion and Akaike information criterion to select the best model out of a few nested alternatives. On the other hand, in order to find significance of each factor for determining North Korea's import behavior we apply an inference

1. See Chung (1978).

procedure for a cointegration relation based on a dynamic regression.

Section II considers some possible models for the import function of North Korea. In Section III we explain econometric methods used for our analysis. Section IV provides empirical results on import behavior of North Korea, and Section V concludes the paper.

II. The Import Function

1. Basic Models

In economics we usually assume that the demand for imports is determined by overall price and the level of national income (see Leamer and Stern (1970)). Assuming log-linearity we have the following econometric model:

$$\log M_t = \beta_0 + \beta_1 \log P_t + \beta_2 \log Y_t + u_t, \qquad (1)$$

where M is the quantity of imports, Y is an income variable, P is a price index, and u is the disturbance.

Alternatively, researchers use slightly modified models of (1) including a lagged dependent variable in the right hand sides of the equation:

$$\log M_t = \beta_0 + \beta_1 \log P_t + \beta_2 \log Y_t + \beta_3 \log M_{t-1} + u_t. \qquad (2)$$

The model (2) can be interpreted as a partial adjustment mechanism for import demand while the model (1) is an equilibrium model. In an equilibrium model the actual quantity of import is always equal to the quantity demanded, which is possible when the quantity adjusts instantaneously to changes in the prices (P) and the income (Y). On the other hand, in the partial adjustment mechanism it takes time for the quantity to adjust.[2]

2. Import Functions for the North Korean Economy

The basic import functions in Section II.1 are applied for many studies (See for example, Khan (1974), Gafar (1988), and Halpern and Szekely (1992).). For analyzing NK's import behavior we augment the basic model of Section II.1 by including some non-market factors such as (1) NK's political relations with China and the former Soviet Union;[3] and (2) open-door polices, especially policies regarding NK's relations with Western industrialized

2. See Khan (1974), Khan and Ross (1977), Boylan *et al.* (1980), and King (1993).

3. Between 1962 and 1992, North Korea has maintained close relations with the two communist "superpowers". However, the conflict between these two allies placed Pyongyang in difficult situations. As the conflict deepened, Pyongyang tried to take advantage of the situation by backing Moscow on some issues and Beijing on others, according to its own national interests, which quite often did not work out well. In most cases conflicts between these two countries had negative effects on the imports of North Korea.

countries.[4]

To augment our basic model in Section II.1 we define some variables for the non-market factors. Denote by *Pol* the country's political relations with the two communist super-powers: *Pol* = 1 for the period of North Korea's leaning toward China, and *Pol* = 0 otherwise.[5] Also, for NK's open door policy we use a variable *Open*: (1) *Open*1 = 1, for the period of 1970-1974 and = 0, otherwise; (2) *Open*2 = 1, for the period of 1975-1983 and = 0, otherwise; and (3) *Open*3 = 1, for the period of 1984-1992 and = 0, otherwise (see footnote 3).

We obtained annual data for the period 1962-1992. Most of data are from the United Nations (UN). Data that are not available from UN are obtained from official publications of North Korea's trading partners. For example, *Zhong-guo Jin-ji Nian-jian* (Almanac of China's Economy) for China, and *Vneshniaia torgovlia SSSR* (Foreign Trade of the USSR) for the Soviet Union.

In Table 1 we have four different models for NK's import behavior discussed above.

Table 1 Alternative Models of NK's Import Demand

A. $\log M_t = \beta_0 + \beta_1 \log P_t + \beta_2 \log Y_t + u_t$

B. $\log M_t = \beta_0 + \beta_1 \log P_t + \beta_2 \log Y_t + \delta \log M_{t-1} + u_t$

C. $\log M_t = \beta_0 + \beta_1 \log P_t + \beta_2 \log Y_t + \beta_3 Pol + \beta_4 Open1 + \beta_5 Open2 + \beta_6 Open3 + \varepsilon_t$

D. $\log M_t = \beta_0 + \beta_1 \log P_t + \beta_2 \log Y_t + \delta \log M_{t-1} + \beta_3 Pol + \beta_4 Open1 + \beta_5 Open2 + \beta_6 Open3 + \varepsilon_t$

Notes: *Pol* is a dummy variable representing the changes of North Korea's relations with China: *Pol* = 1, for $1962 \le t \le 1964$ or $1969 \le t \le 1978$ or $1982 \le t \le 1983$ or $1988 \le t \le 1992$, and *Pol* = 0, for otherwise.

Model A is the equilibrium model (1), and model B is the model (2) for the partial adjustment mechanism. Models C and D are, respectively, augmented versions of models A and B including our non-market factors.

III. Model Selection and Inference

1. Model Selection

We want to choose the most appropriate model among the four alternative specifications

4. During the period of 1962-1992 North Korea's open-door policy changed three times: (1) expansion of imports and attraction of a foreign loan from Western industrialized countries (1970~1974); (2) shrinking back to the closed economy mostly due to the foreign debts problem (1975~1983); (3) attraction of foreign investment under the debts problem (1984~1992). See Tamaki (1988).

5. North Korea's relations with China and the former Soviet Union has changed by the following way: (1) 1962-1964: leaning toward China; (2) 1965-1968: leaning toward Soviet; (3) 1969-1978: positive neutrality while leaning slightly toward China; (4) 1979-1981: leaning toward Soviet; (5) 1982-1983: leaning toward China; (6) 1984-1987: leaning toward Soviet; and (7) 1988-1992: leaning toward China. See Chung (1978) and Clough (1987).

in Table 1 for NK's import function. First of all we need to know whether each of the models under consideration is a stable dynamic system. A widely used concept relevant to dynamic stability is the idea of a long-run equilibrium implied by cointegration, which is particularly so in a dynamic system containing nonstationary variables. All three of our variables, $\log M_t$, $\log P_t$ and $\log Y_t$ are found to be $I(1)$ processes. Thus, in order to make sure that a model has some economic relevance as a stable system, we need to check whether or not the model is cointegrated. After finding that some models are cointegrated, we choose the model that best fits the data out of a set of cointegrated models. Since models A-D in Table 1 form a set of nested models, we can apply such decision criteria as Akaike (1973) information criterion (AIC) and Bayesian information criterion (BIC) to select a model out of those nested alternatives.[6]

2. Significance of Each Factor

For a system with $I(1)$ variables standard classical inference on significance of variables, which is based on normal distribution theory, often fails to apply. However, if the system forms a cointegrated relation, we can apply standard classical inference in some cases for testing significance. For example, consider the following system

$$y_{1t} = \alpha + \gamma' \mathbf{y}_{2t} + z_t^*, \tag{3}$$

$$\mathbf{y}_{2t} = \mathbf{y}_{2t-1} + \mathbf{u}_{2t}, \tag{4}$$

where y_{1t} is a scalar and $\mathbf{y}_{2t}$ is a $k \times 1$ vector. If y_{1t} and $\mathbf{y}_{2t}$ are both $I(1)$ but z_t^* and $\mathbf{u}_{2t}$ are $I(0)$, then, for $n = k+1$, the n-dimensional vector $(y_{1t}, \mathbf{y}_{2t}')'$ is cointegrated with the cointegration relation given by (3). For a special case when z_t^* and $\mathbf{u}_{2t}$ are uncorrelated i.i.d. processes with mean zero and finite variances, the asymptotic distribution of the ordinary least square estimator of the coefficients $(\alpha, \gamma')'$ conditional on $(\mathbf{y}_{21}, \mathbf{y}_{22}, \ldots, \mathbf{y}_{2T})$ is jointly normal.

However, the assumption of uncorrelatedness of z_t^* and $\mathbf{u}_{2t}$ is hard to hold for many cases of practical interest. In the case when z_t^* and $\mathbf{u}_{2t}$ are correlated, Phillips and Loretan (1991), Saikkonen (1991) and Stock and Watson (1993) suggest to correct the problem by augmenting the Equation (3) with leads and lags of $\Delta \mathbf{y}_{2t}$. More specifically, the augmented regression is

$$y_{1t} = \alpha + \gamma' \mathbf{y}_{2t} + \sum_{s=-p}^{p} \beta_s' \Delta \mathbf{y}_{2,t-s} + \tilde{z}_t, \tag{5}$$

6. We use BIC studied in Phillips (1996) and Kim (1998) for models with nonstationary variables.

where $\tilde{z}_t$ is the residual of a linear projection of z_t^* on $\mathbf{u}_{2t-s} = \Delta \mathbf{y}_{2t-s}$ for $s = -p, -p+1, \ldots, p$. Then, by construction $\tilde{z}_t$ is uncorrelated with $\mathbf{u}_{2t-s} = \Delta \mathbf{y}_{2t-s}$ for $s = -p, -p+1, \ldots, p$. The lag-length p is chosen so that z_t^* and $\mathbf{u}_{2t-s}$ for $|s| > p$ are not correlated. For the regression model (5), standard asymptotic theory applies for the sampling behavior of the estimator of the coefficient $(\alpha, \gamma')'$ conditional on $(\mathbf{y}_{21}, \mathbf{y}_{22}, \ldots, \mathbf{y}_{2T})$. In this case the F test-statistic for testing a linear restriction on the coefficient has an asymptotic χ^2 distribution multiplied by a constant. More specifically, for testing the null hypothesis $H_o: R\gamma = r$, the *F*-statistic has the following asymptotic property:

$$F_T \xrightarrow{p} \left(\tilde{\lambda}^2 / s_T^2\right) \chi^2(m) \tag{6}$$

where m is the number of restrictions in the null hypothesis; s_T^2 is the limit of,

$$(T-n)^{-1} \sum_{t=1}^{T} \left(y_{1t} - \hat{\alpha} - \hat{\gamma}' \mathbf{y}_{2T} - \sum_{s=-p}^{p} \hat{\beta}_s' \Delta y_{2,t-s} \right)^2$$

and $\tilde{\lambda} = s\psi(1)$ for $\tilde{z}_t = \psi(L) \cdot \varepsilon_t$ with ε_t being a white noise. Consistent estimators of the multiplicative factor of the *F*-statistic are discussed in Phillips and Loretan (1991), Saikkonen (1991) and Stock and Watson (1993). In practice, for determining p we can use BIC and AIC.

3. Results from Aggregate Data

For explanatory purposes we apply in this section the econometric methods explained above for aggregate data. Our main empirical analysis is discussed in Section IV for disaggregate data. As shown in Table 2 below the unit root hypothesis is not rejected for all the three variables, $\log M_t$, $\log P_t$ and $\log Y_t$ with the augmented Dickey-Fuller (ADF) *t*-test. For all these three variables the unit root hypothesis cannot be rejected even at 10% level.

Table 2 The Results of Unit Root Test

	$\log M_t$	$\log Y_t$	$\log P_t$
ADF *t*-statistic	-1.77	-1.58	-1.69

Note: The 10% critical value is -3.23.

In Table 3 we provide the results of cointegration test and the values of BIC and AIC for each of the models A-D for the aggregate data. We find that models C and D are cointegrated while models A and B are not (by 5% ADF *t*-test). Hence, the models C and D are stable dynamic systems while the models A and B are not. On the other hand, both BIC and AIC have minimum values for the model D. We, therefore, choose the model D as the best model for North Korea' s import behavior.

Table 3 Cointegration Test and Information Criteria

	Cointegration Test		Model Selection	
	ADF *t*-stat.	Conclusion	AIC	BIC
Equation A	-3.35 (-3.80)	not cointegrated	-2.85	-2.71
Equation B	-3.60 (-4.16)	not cointegrated	-3.22	-3.03
Equation C	-4.89 (-3.80)	cointegrated	-3.07	-2.75
Equation D	-5.11 (-4.16)	cointegrated	-3.45	-3.08

Note: The values in the parentheses are 5% critical values for rejecting the null of no cointegration.

Now, we want to explain results on significance of each factor (Section III.2) for the aggregate data. Correlation coefficients between the disturbance of model D (z_t^*) and each of differences of regressors ($\Delta \mathbf{y}_{2t}$) are shown in Table 4 Correlation between $\Delta \log M_{t-1}$ and the residual of model D is not small, while correlation between $\Delta \log P$ and the residual and correlation between $\Delta \log Y$ and the residual are relatively small.

Table 4 Correlation Matrix

	$\Delta \log M_{t-1}$	$\Delta \log P$	$\Delta \log Y$	Residuals of Equation D
$\Delta \log M_{t-1}$	1.000	-0.353	0.293	0.323
$\Delta \log P$	-0.353	1.000	-0.546	-0.046
$\Delta \log Y$	0.293	-0.546	1.000	-0.022
Residuals of Equation D	0.323	-0.046	-0.022	1.000

Table 5 provides the results of augmenting the model D by adding various combinations of different components of $\Delta \mathbf{y}_{2t}$. For each model we can compute the values of BIC and AIC to have the best choice for the value of p. The result is $p = 0$.

Table 5 Correction for the Correlation between Difference of Regressors and Residual of Augmented Equation

Correction for the Correlation			Model Selection		New Correlation with Residuals		
No.	Lists of Adjustment	lag-length	AIC	BIC	$\Delta \log M_{t-1}$	$\Delta \log Y_t$	$\Delta \log P_t$
#1	$\Delta \log M_{t-1}, \Delta \log P, \Delta \log Y$	$p = 0$	–3.54	–3.02	–1.69E-16*	–1.85E-16*	3.07E-15*
#2	$\Delta \log M_{t-1}, \Delta \log Y$	$p = 0$	–3.59	–3.12	–5.18E-16*	0.059	2.79E-15*
#3	$\Delta \log M_{t-1}, \Delta \log P$	$p = 0$	–3.60	–3.13	3.13E-16*	–3.66E-16*	–0.029*
#4	$\Delta \log M_{t-1}$	$p = 0$	–3.64	–3.21	–5.37E-16*	0.144	–0.138

* : The null of no correlation is not rejected at 5% level.

For the augmented regression (5) including *Open*1 as well as other variables, we find that *Open*1 is insignificant in all cases under consideration (Table 6) while other variables are significant in all the cases based on 5% test. Also, the regression without *Open*1 yields lower values of AIC and BIC in each case than the regression with *Open*1.

Table 6 Difference Between Including and Excluding *Open*1

Constant	$\log Y_t$	$\log P_t$	$\log M_{t-1}$	Correction* for Correlations	*Pol*	*Open*1	*Open*2	*Open*3	$\overline{R}^2$ (*F*-Stat)	BIC (AIC)
–2.630	1.124	0.580	0.202	$\Delta\log M_{t-1}$,	–0.090	0.053	–0.357	–0.549	0.977	–3.02
(6.00)	(10.96)	(0.56)	(0.77)	$\Delta\log P$,	(1.28)	(0.11)	(1.28)	(1.85)	(75)	(–3.54)
–2.776	1.187	0.661	0.192	$\Delta\log Y$	–0.090	-	–0.424	–0.648	0.976	–3.13
(8.47)	(18.92)	(0.86)	(0.76)		(1.35)		(6.10)	(6.04)	(87)	(–3.60)
–2.719	1.117	0.761	0.244		–0.101	0.053	–0.363	–0.599	0.976	–3.12
(6.92)	(11.36)	(1.39)	(1.42)	$\Delta\log M_{t-1}$,	(1.85)	(0.12)	(1.90)	(2.50)	(87)	(–3.59)
–2.864	1.180	0.841	0.234	$\Delta\log Y$	–0.101	-	–0.430	–0.699	0.976	–3.23
(9.73)	(19.54)	(2.07)	(1.42)		(1.93)		(6.55)	(9.36)	(102)	(–3.66)
–2.590	1.122	0.518	0.192		–0.088	0.049	–0.357	–0.532	0.976	–3.13
(6.35)	(11.56)	(0.56)	(0.77)	$\Delta\log M_{t-1}$,	(1.32)	(0.10)	(1.85)	(1.93)	(88)	(–3.60)
–2.735	1.182	0.606	0.185	$\Delta\log P$	–0.088	-	–0.420	–0.630	0.976	–3.24
(9.86)	(19.98)	(0.98)	(0.76)		(1.37)		(6.45)	(8.01)	(103)	(–3.67)

Note: The *t*-value is provided in each parenthesis below the coefficient estimate; *: Listed variables are included as regressors for correcting the correlations between difference of regressors and the residual.

In sum, we have the following specification as the best model for the import function of North Korea for the aggregate data:

$$\log M_t = \alpha_0 + \alpha_1 \log P_t + \alpha_2 \log Y_t + \alpha_3 \log M_{t-1} + \alpha_4 \quad \text{(Correction with a set of}$$

$$\Delta \log M_{t-1}, \Delta \log Y, \Delta \log P) + \alpha_5 Pol + \alpha_6 Open2 + \alpha_7 Open3 + \varepsilon_t . \qquad (7)$$

IV. Regression Results of North Korean Import Function: For Different Countries and Different Commodity Groups

In this section we provide some empirical results on the import behavior of NK for imports from different countries and for different commodity groups. For each disaggregate data we examine all the possible model specifications that are discussed in the previous section based on the model D.

1. Imports from Different Countries

We have data on each of the variables from 1962 through 1992.[7] The volume of imports (M_t) is the value of imported goods, the exchange rate is used for the relative price

7. Since North Korea has not released any trade-related data since the mid-1960s, our data are obtained from the corresponding quantities reported by North Korea's trading partners.

(P_t), and the real GNP is used for the real income (Y_t).[8] Table 7 provides the results of estimating variants of (7) for data from different countries. The model for each country presented in Table 7 is the most appropriate model based on the procedure in Section III.[9]

The income elasticity of imports is higher for imports from capitalist countries than that for imports from communist countries. Notice that the income elasticity for imports from developing capitalist countries is the highest while that from China is the lowest. It implies that communist countries, especially China, is the most stable supplier to North Korean economy. On the other hand, the relative price P is not statistically significant at the 5% level for each country, which confirms the common view that relative prices are not important factors determining the volume of imports in communist countries.[10]

Table 7 Estimated Regression Equations of NK's Imports: by Countries

	Const.	$\log Y_t$	$\log P_t$	$\log M_{t-1}$	Correction* for Correlations	*Pol*	*Open*2	*Open*3	$\bar{R}^2$ (*F*-Stat.)	BIC (AIC)
Total	–2.735	1.182	0.606	0.185	$\Delta\log M_{t-1}, \Delta\log P$	–0.088	–0.420	–0.630	0.976	–3.24
	(9.24)	(19.98)	(0.98)	(0.76)		(1.37)	(6.45)	(8.01)	(103)	(–3.67)
Communist	–2.000	0.734	0.194	0.214	$\Delta\log M_{t-1}, \Delta\log P$	–0.006	–0.242	–0.112	0.945	–2.72
Countries	(4.24)	(7.02)	(0.06)	(0.79)		(0.00)	(1.19)	(0.15)	(43)	(–3.14)
USSR/CIS	–2.654	0.802	0.256	0.246	$\Delta\log M_{t-1}, \Delta\log P$	0.006	–0.419	–0.133	0.903	–1.76
	(2.86)	(3.84)	(0.04)	(1.08)		(0.00)	(1.10)	(0.08)	(23)	(–2.18)
China	–1.762	0.401	–0.058	0.474	$\Delta\log M_{t-1}, \Delta\log Y$	0.059	0.015	–0.072	0.932	–2.57
	(3.42)	(3.57)	(0.01)	(7.56)		(0.36)	(0.00)	(0.04)	(35)	(–3.00)
Other	–3.571	0.836	–0.211	0.114	$\Delta\log M_{t-1}, \Delta\log Y$	0.052	–0.269	–0.398	0.901	–2.20
Countries	(4.20)	(4.97)	(0.05)	(0.18)		(0.19)	(1.02)	(1.02)	(23)	(–2.63)
Capitalist	–4.863	1.910	1.146	0.377	$\Delta\log M_{t-1}, \Delta\log Y$	–0.247	–0.925	–1.794	0.969	–2.06
Countries	(5.57)	(15.52)	(0.81)	(4.28)		(3.28)	(8.24)	(18.15)	(78)	(–2.49)
Japan	–8.412	2.611	2.391	0.128	$\Delta\log M_{t-1}, \Delta\log P$	–0.385	–0.728	–2.241	0.935	–1.22
	(7.40)	(13.84)	(1.54)	(0.29)		(2.86)	(2.56)	(12.46)	(36)	(–1.64)
OECD**	–2.280	1.282	–0.064	0.668	$\Delta\log M_{t-1}, \Delta\log P$	–0.224	–1.445	–1.871	0.891	–1.15
Countries	(0.77)	(6.25)	(0.00)	(12.39)		(1.10)	(9.12)	(9.36)	(21)	(–1.58)
Developing	–8.413	3.250	0.411	0.160	$\Delta\log M_{t-1}, \Delta\log Y$	–0.480	–1.574	–2.466	0.963	–1.01
Countries	(5.43)	(12.32)	(0.05)	(0.44)		(4.54)	(8.24)	(9.92)	(66)	(–1.43)

Notes: The *t*-value is provided in each parenthesis below the coefficient estimate; * : Listed variables are included as regressors for correcting the correlations between difference of regressors and residual; ** : Japan is not included in OECD countries.

8. Since North Korea has not published any consistent data on GNP, we use the values estimated by South Korean National Unification Board.

9. Although we do not include the results of cointegration test in Tables 7 - 9, we checked that the models in the tables are all cointegrated ones.

10. See Houthakker and Magee (1969) and Magee (1975).

Another piece of evidence found in Table 7 is that the change in North Korea's political relations with China and USSR, which is characterized by *Pol*, did not have significant impacts on imports from these two superpowers. This implies that the two communist superpowers were overall stable suppliers to North Korean economy, and the total value of imports from the two countries is not much affected by the political situation. On the other hand, however, the change did have significant negative impacts on imports from the capitalist countries. One implication of this result is that the items imported from the two communist superpowers were different, and Sino-Soviet dispute might have impacts on imports of certain items. Then, Western industrialized countries filled the deficiency, if any, caused by Sino-Soviet dispute. Also, recalling that $Pol = 1$ for the period leaning toward China, the negative impacts on imports from capitalist countries imply that North Korea imported less from the capitalist countries for the period leaning toward China.

On the other hand, problems from foreign debts characterized by *Open*2 and *Open*3 had significant impacts on the amount of imports. Especially the debt problem had considerable negative impacts on imports from capitalist countries. Also, imports were not improved by the new open-door policy initiated by Joint Venture Law of 1984, the beginning year of *Open*3. Instead, foreign debt problems were reducing the amount of NK's imports even more as time went on despite the new open-door policy. This implies that the lost credit caused by the accumulated foreign debts damaged the economic relation between North Korea and the capitalist countries and that the relation was not improved by the new open door policy.

2. For Different Commodity Groups

Table 8 provides the results of estimation for different commodity groups. Data on each variable are the aggregation of imports from non-communist countries and from the former USSR.[11] For all commodity groups the income appears to be a significant variable in explaining imports except two cases, SITC 2 and SITC 3 (crude materials including mineral Fuels). In fact, income elasticity of imports is greater than unity for all groups of commodities except these two cases. Relative price, on the other hand, is not statistically significant at 5% level for all groups.

On the other hand, the impacts of non-economic factors are not uniform across different commodity groups. Political changes are statistically significant in determining the imports of crude material including fuels (SITC 2 and SITC 3) and food & live animals (SITC 0). The negative values of the coefficient of *Pol* implies that more of these products are imported from the former Soviet Union than from China. The foreign debt problem of North Korea, characterized by *Open2* and *Open3*, has significantly negative impacts on imports of food & live animals, manufactured goods and machinery (SITC 0, SITC 4, SITC 6, SITC 7, and SITC 8).

11. The data categorized by UN's SITC (Standard International Trade Classification) code is available only for capitalist countries and the former USSR during 1962-1992.

Table 8 Results from Capitalists+USSR: by Commodity Groups

	Const.	$\log Y_t$	$\log P_t$	$\log M_{t-1}$	Correction* for Correlations	*Pol*	*Open*2	*Open*3	$\overline{R}^2$ (*F*-Stat.)	BIC (AIC)
Capitalists	–3.493	1.344	1.102	0.346	$\Delta\log M_{t-1}, \Delta\log P$	–0.177	–0.631	–1.002	0.965	–2.57
& USSR	(6.55)	(12.89)	(1.56)	(2.56)		(2.86)	(7.90)	(10.37)	(70)	(–3.00)
SITC 0	–11.48	4.088	2.771	–0.116	$\Delta\log M_{t-1}, \Delta\log Y$	–1.082	–2.628	–5.388	0.646	0.55
	(6.66)	(15.52)	(0.59)	(0.18)		(5.29)	(5.95)	(12.53)	(4.6)	(0.12)
SITC 1	–23.26	4.879	7.474	–0.009	$\Delta\log M_{t-1}, \Delta\log Y$	–0.182	–1.074	–2.077	0.923	0.30
	(8.35)	(8.64)	(3.84)	(0.00)		(0.14)	(1.21)	(1.77)	(27)	(–0.13)
SITC 2	–0.763	0.543	–1.074	0.686	$\Delta\log M_{t-1}, \Delta\log Y$	–0.345	–0.475	–0.696	0.946	–2.21
	(0.19)	(2.34)	(1.19)	(12.74)		(7.73)	(2.82)	(3.10)	(44)	(–2.63)
SITC 3	–3.464	0.619	1.476	0.578	$\Delta\log M_{t-1}, \Delta\log Y$	–0.325	0.231	–0.086	0.930	–1.75
	(5.20)	(2.92)	(1.72)	(14.52)		(4.58)	(0.46)	(0.03)	(33)	(–2.18)
SITC 4	–7.645	1.969	1.068	0.268	$\Delta\log M_{t-1}, \Delta\log P$	–0.396	–1.524	–2.117	0.836	–0.80
	(6.50)	(9.24)	(0.25)	(3.31)		(2.16)	(7.02)	(6.60)	(13)	(–1.22)
SITC 5	–6.825	1.533	0.629	0.004	$\Delta\log M_{t-1}, \Delta\log P$	–0.244	–0.038	–0.510	0.975	–2.70
	(8.01)	(9.67)	(0.50)	(0.00)		(3.20)	(0.03)	(3.10)	(99)	(–3.12)
SITC 6	–3.876	1.411	–0.188	0.296	$\Delta\log M_{t-1}, \Delta\log P$	–0.157	–0.898	–1.098	0.963	–2.28
	(8.24)	(26.52)	(0.04)	(2.43)		(1.74)	(7.45)	(6.30)	(64)	(–2.70)
SITC 7	–6.611	1.898	2.456	0.184	$\Delta\log M_{t-1}, \Delta\log Y$	–0.156	–0.820	–1.670	0.927	–1.91
	(9.67)	(16.24)	(3.57)	(0.77)		(1.28)	(7.02)	(12.74)	(32)	(–2.33)
SITC 8	–8.397	1.829	1.228	–0.014	$\Delta\log M_{t-1}, \Delta\log Y$	0.011	–0.552	–0.905	0.978	–2.79
	(16.08)	(22.85)	(2.34)	(0.00)		(0.01)	(7.24)	(10.24)	(111)	(–3.22)

Notes: The *t*-value is provided in each parenthesis below the coefficient estimate; * : Listed variables are included as regressors for correcting the correlations between difference of regressors and residual.

SITC 0: Food & Live Animals; SITC 1: Beverages & Tobacco; SITC 2: Crude Materials except Fuels; SITC 3: Mineral Fuels; SITC 4: Animal & Vegetable Oils; SITC 5: Chemicals; SITC 6: Basic Manufactured Goods; SITC 7: Machinery & Transport Equipment; SITC 8: Miscellaneous Manufactured Goods.

Table 9 Results from the Non-communist Countries: by Commodity Groups

	Const.	$\log Y_t$	$\log P_t$	$\log M_{t-1}$	Correction* for Correlations	*Pol*	*Open*2	*Open*3	$\overline{R}^2$ (*F*-Stat.)	BIC (AIC)
Capitalist	–4.863	1.910	1.146	0.377	$\Delta\log M_{t-1}, \Delta\log Y$	–0.247	–0.925	–1.794	0.969	–2.06
Countries	(5.57)	(15.52)	(0.81)	(4.28)		(3.28)	(8.24)	(18.15)	(78)	(–2.49)
SITC 0	–20.99	6.675	7.998	–0.275	$\Delta\log M_{t-1}, \Delta\log P$	–1.753	–3.859	–7.996	0.698	0.99
	(11.36)	(24.30)	(2.50)	(1.04)		(8.76)	(8.64)	(19.10)	(5.8)	(0.57)
SITC 1	–23.26	4.879	7.474	–0.009	$\Delta\log M_{t-1}, \Delta\log Y$	–0.182	–1.074	–2.08	0.923	0.30
	(8.35)	(8.64)	(3.84)	(0.00)		(0.08)	(1.21)	(1.77)	(27)	(–0.13)
SITC 2	–2.008	1.062	–0.546	0.715	$\Delta\log M_{t-1}, \Delta\log Y$	–0.449	–0.829	–1.418	0.962	–1.39
	(0.38)	(2.02)	(0.10)	(14.59)		(4.49)	(4.20)	(4.37)	(63)	(–1.81)
SITC 3	–10.62	2.873	–0.803	0.129	$\Delta\log M_{t-1}, \Delta\log Y$	–0.567	0.208	–0.759	0.887	0.65
	(2.16)	(2.76)	(0.04)	(0.16)		(0.77)	(0.03)	(0.17)	(19)	(0.23)
SITC 4	–12.38	3.127	–1.353	–0.303	$\Delta\log M_{t-1}, \Delta\log P$	–0.815	–1.173	–1.242	0.913	–0.40
	(13.40)	(20.88)	(0.29)	(1.96)		(6.30)	(2.92)	(1.72)	(26)	(–0.82)
SITC 5	–10.27	2.447	1.120	–0.234	$\Delta\log M_{t-1}, \Delta\log P$	–0.352	0.088	–0.825	0.975	–2.22
	(9.73)	(11.90)	(0.85)	(0.53)		(3.17)	(0.09)	(4.67)	(99)	(–2.64)
SITC 6	–6.610	2.188	0.870	0.240	$\Delta\log M_{t-1}, \Delta\log Y$	–0.189	–0.971	–1.748	0.943	–1.21
	(6.71)	(16.65)	(0.27)	(1.28)		(0.92)	(3.31)	(7.45)	(42)	(–1.64)
SITC 7	–7.467	2.313	2.230	0.277	$\Delta\log M_{t-1}, \Delta\log Y$	–0.162	–0.957	–2.201	0.904	–0.91
	(5.48)	(9.92)	(1.12)	(2.19)		(0.48)	(3.39)	(7.51)	(24)	(–1.33)
SITC 8	–7.304	2.070	0.890	0.342	$\Delta\log M_{t-1}, \Delta\log P$	–0.117	–0.906	–1.422	0.975	–1.74
	(6.05)	(11.16)	(0.41)	(2.56)		(0.58)	(6.66)	(8.76)	(99)	(–2.16)

The results in Table 8 are almost the same, with few exceptions, as those of Table 9 which reports the results from data of non-communist countries only. Among the exceptions are the commodity groups SITC 2 (crude material except fuels) and SITC 5 (chemicals). More specifically, different from Table 8 *Open*2 and *Open*3 have negative impacts on the imports of SITC 2, and *Open*3 has negative impacts on the imports of SITC 5. This difference in Table 9 from Table 8 implies that the foreign debts problem has negative impacts on the import of crude material during 1975-1992 and that of chemicals during 1984-1992 from non-communist countries. In Table 9 we can also notice that the foreign debt problem has significantly negative impacts on the imports of all groups of commodities (except SITC 1and SITC 3) from non-communist countries. It shows how serious the resulting damage of credit loss was to North Korean economy.

V. Concluding Remarks

We have studied some aspects of North Korean economy through its import behavior for which data are available from its trading partners. We have found that for North Korean economy some non-market factors are important determinants of the import behavior. Among several results the ones with the following two implications are of particular interests. First, the two communist superpowers were overall stable and the most important suppliers to North Korean economy regardless of the political situation while Western industrialized countries filled the deficiency, if any, caused by Sino-Soviet dispute. Second, the foreign debts problem had significantly negative impacts on imports from the capitalist countries for most commodity groups, which is true even after the new open door policy initiated by the Joint Venture Law of 1984, implying that the lost credit caused by the accumulated foreign debts damaged the economic relation between North Korea and the capitalist countries and that the relation was not recovered by the new open door policy.

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