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An Econometric Analysis of Imported Softwood Log Markets in South Korea
– on the Basis of the Lagged Dependent Variable –

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Abstract : The objective of this study is to know market structures of softwood logs being imported to South Korea from log producing countries. Import demand of softwood logs imported to South Korea from America, New Zealand and Chile is fixed as a function of log prices, the lagged dependent variable and output. On the basis of the adaptive expectations model, linear regression models that the explanatory variables included and the lagged dependent variable were estimated by Seemingly Unrelated Regression Equations (SURE). The short-run and long-run own price elasticity of America's softwood log import demand is -1.738 and -4.250 respectively. Then long-run elasticity is much higher than short-run elasticity. Short-run and long-run cross-elasticity of New Zealand's softwood log import demand with respect to American's softwood log import price are inelastic at 0.505 and 0.883 respectively. Short-run and long-run cross-elasticity of Chile's softwood log import demands with respect to American's softwood log import prices were highly elastic at 2.442 and 4.462 respectively. Long-run elasticity was almost twice as high as short-run elasticity.

***Key words* :** *lagged dependent variable, adaptive expectation model, seemingly unrelated regression equations (SURE)*

Introduction

In a recent movement of log producing countries and with the conditions of South Korea's wood industry, by the late 1970s, South Korea was the largest tropical plywood exporter among all major global tropical plywood exporters. The plywood industry led most other industries domestically. From the mid 1980s, most tropical log producing countries didn't export tropical logs to protect their domestic forest industry and to bring up their domestic high value added industry. Indonesia didn't export completely tropical logs to South Korea in 1985. So far South Korea's plywood and lumber industrials using tropical log were collapsed. Malaysia banned exports of tropical logs from its peninsula since 1972 and in the Sabah since 1992 to South Korea. Also, since the Brazil Rio environmental development meeting held in June of 1992, because of the spread of the world forest environmental protection movement, the controls and restrictions on tropical log harvests were tighter. Because softwood was regarded as a high artificial forest ratio and species were being produced in a sustainable forest management region, during a Brazil Rio environmental development meeting, the controls and restrictions on softwood log harvesting were lowered.

On the other hand tropical hardwood log imports decreased rapidly and softwood log imports increased rapidly as construction rose. In volumes of softwood logs imported to South Korea from softwood log producing countries, most of them were imported from America, New Zealand and Chile. South Korea's import of America's softwood log fell from 2.2 million to 524 thousand m^3 between 1990 and 1996, due to Oregon state's forest sustained management policy and protection of the spotted owl in the Northern Region.

Because America's softwood log export prices rose, South Korea imported softwood logs from New Zealand and Chile. South Korea's imports of New Zealand’s softwood log rose rapidly from 1.183 million to 3.144 million m^3 between 1990 to 1997. Also, South Korea's imports of Chile's softwood logs rose rapidly from 555 thousand to 1.407 million m^3 between 1990 and 1997.

Timber price is an important economic variable in the forestry and connected industries and timber trade coun-

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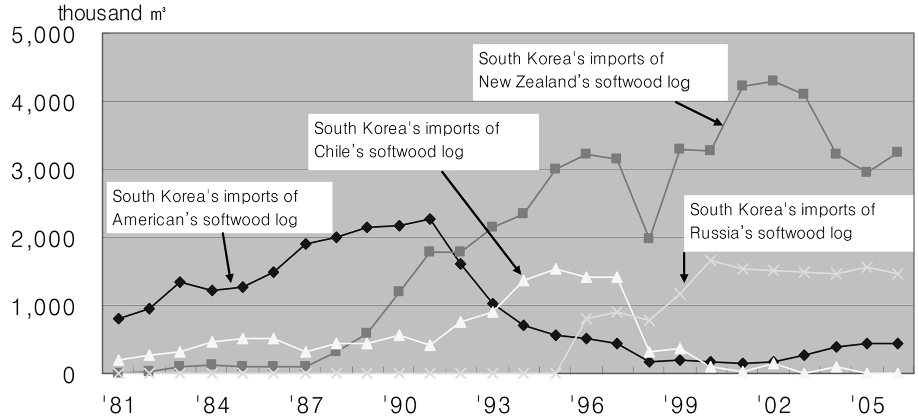

Figure 1. Trends of South Korea's imports of countries's softwood log.

tries. Timber industries using timber imported from timber producers are especially competitive in minimizing production costs. So they are to meet rapidly the situation that timber prices fluctuate.

Therefore, regarding South Korea's important timber import determinant factors, it is very important not only to analyze qualitatively trade factors between South Korea and timber producing countries by theoretical model but also to analyze quantitatively timber volumes imported from producers and the importance of factors affecting them by econometric method. But past studies related to this have studied mainly the development of the forecast model of timber demand until recently.

Past studies of South Korea's log demand forecast models have been produced by linear models from the late 1960s: (Park 1967; Cho 1973; Cho 1976; Choi 1977; O 1980; Kim 1980; Sung 1986; Park 1989; Youn 1992). And these studies employed that the relation of dependent and independent variables was commonly effect and cause. But (Joo 1998) developed demand and supply models of timber goods (lumber, plywood, MDF, particleboard) and domestic logs based on market economic theory by 2SLS or OLS.

Past studies have considered chiefly explanatory variables to be current values, building permit area, construction values, GDP and population. But with enterprises' log purchases, they consider not only current values but also precious values. Therefore papers have to be studied about the lagged variable too. In past domestic papers, (Kim 1998) attempted only to study the lagged variable related to timber.

In foreign studies, (Brannlund *et al.,* 1985) examined the impact of endogenous lagged variable on Sweden's lumber demand. (Adams *et al.,* 1992) used lagged variable in estimation on the U.S. lumber demand by end-use sector. Under situations where major volumes of timber demand are imported from foreign countries, changes in the timber export prices of each producing country have affected volumes of imported timber in South Korea on the short and long-term. In related studies, (Park and Youn 2001) investigated that volumes of imported timber to South Korea from each producing country affected changes of timber's export prices of each producing country.

This study is to develop import demand market models of softwood logs imported from South Korea's softwood log producers America, New Zealand and Chile and analyze how to affect volumes of South Korea's log import by changes of log export prices by log producing countries.

Research Range

South Korea's softwood log markets are domestic's and import's. Volumes of softwood logs behind diameter 20 cm produced in South Korea are about 80 per cent of domestic's log production quantity. So they are used primarily as pulpwood and drift log. Because the diameter of imported softwood logs are almost over 30 cm, they are used in residential construction, residential buildings, softwood plywood and others.

This study assumes that domestic and import logs aren't interactive, and exclude domestic softwood logs. This study only includes America's, New Zealand's and Chile's softwood log import markets. An effort was make in this study to collect objective, precise and rational analysis data. Volumes of softwood logs imported from the U.S., New Zealand and Chile and their values were selected in South Korea's trade statistic annual report (1981-1997). Softwood log import values per m^3 were deflated as.[1)] Producer price indexes were selected in monthly statistics of South Korea.

[1)] dollar($)×annual average exchange rates to U.S.dollar-producer÷price indexes×100

Analysis Model and Estimate Method

Softwood logs imported in South Korea are processed first by uses in lumber mills. Subsequently the proceeded lumbers flow in building, civil engineering, furniture, instrument, and others.

Softwood log demand is derivative demand. After softwood logs are made lumbers in mills, they are used to end-use. And the softwood log demand model analyzed with the production factor demand function derived from benefit or cost function. That is to say, in level of the given output and product prices, a firm behaves cost minimization or profit maximization.

Analysis Model

A model made under the assumptions of a firm's price-taking behavior in output markets may be very irrational in many cases.

For example if a firm is a single supplier of the output in any case when it determines supply of output, it should consider its own influence on prices. But however the firm determines quantity of supply of output, it is clear that the firm will produce output at the best minimum cost. Softwood log import demand models were derived from conditional production factor demand function based on the firm's cost-minimizing theory.

The assumptions made for modeling South Korea's softwood log import markets by producer countries are as follows.

1) The producers of the composite inputs are cost minimizers.

2) Domestic and import logs aren't competitive with one another.

3) Imported softwood logs and tropical hardwood logs do not have a substitutive relationship. Namely their prices aren't affected mutually.

4) The levels of softwood logs being imported to South Korea from producer countries are constant over time.

5) Volumes of imported softwood logs in the current year are affected by not only imported softwood log's price and volumes of output in the current year but also imported softwood log's price and volumes of output in the previous year.

6) Import demand equations by producer countries are linear.

Theoretical Model[2]

In many situations it is not reasonable to model a firm as taking its output prices as given. For example, if the firm is the sole supplier of some product we would expect that it would take into account its influence on the market price when it determined its supply of output. However, regardless of how the firm determines its supply of output, it is clear that it would like to produce this supply of output in the cheapest possible manner.[2]

In this study as lumber mills would like to produce this supply of output in the cheapest possible manner, the objective function can be written as:

$$c(w,\ y) = \min TC = \sum_{i=1}^{n} w_i x_i \qquad (1)$$

$$\begin{aligned} s.t.\ \ & y = f(x_1, x_2, \ldots, x_n) \\ & x_1 \geq 0 \\ & \vdots \\ & x_n \geq 0 \end{aligned}$$

where c is cost, x_1, x_2, ..., x_n are inputs(America's softwood log quantity, New Zealand's softwood log quantity, Chile's softwood log quantity, labor, other materials), w_1, w_2, ..., w_n are prices of inputs (America's softwood log price, New Zealand's softwood log price, Chile's softwood log price, labor price and other materials price) and y is output (America's softwood lumber + New Zealand's softwood lumber + Chile's softwood lumber).

The Lagrangean for formula (1) can be written as:

$$L = \sum_{i=1}^{n} w_i x_i + \lambda[y - f(x_1, x_2, \ldots, x_n)] \qquad (2)$$

The first-order condition is:

$$\frac{\partial L}{\partial x_i} = w_i - \lambda f_i = 0 \qquad i = 1, 2, \ldots, n \qquad (3)$$

$$\frac{\partial L}{\partial \lambda} = y - f(x_1, x_2, \ldots, x_n) = 0 \qquad (4)$$

which gives us the conditional demand function for each factor.

Based on Cagan's adaptive expectations model, Softwood log import demand equations involving the lagged endogenous variable by assumption 5) can be derived as

$$\begin{aligned} x_1 &= x_1(w_1, w_2, \ldots, w_n, x_1(-1), y) \\ x_2 &= x_1(w_1, w_2, \ldots, w_n, x_2(-1), y) \\ &\vdots \\ x_n &= x_n(w_1, w_2, \ldots, w_n, x_n(-1), y) \end{aligned} \qquad (5)$$

Eq. (6), (7) and (8) form the general basis for our empirical analysis. Economic theories for factors of conditional factor demand functions by softwood log import markets can be represented as

[2] Varian, H.R. 1984. Microeconomic Analysis P23. Second Edition

1. American's softwood log import demand model

$$IMPLOG_{AMEP} = \gamma_{111} + \beta_{111}P_{IMPLOG_{AMEP}} + \beta_{112}P_{IMPLOG_{NWP}} + \beta_{113}P_{IMPLOG_{CHLP}} + \beta_{114}IMPLOG_{AMEP}(-1) + \beta_{115}PDT_{TLB} + u_{11} \quad (6)$$

Signal of own log price $\beta_{111}P_{IMPLOG_{AMEP}}$ is to be minus in eq. (6). That is, if America's softwood log import prices rise, America's softwood log import quantities will decrease. Also, if America's softwood log import prices decrease, America's softwood log import quantities will rise. In the case of plus of signals of $\beta_{112}P_{IMPLOG_{NWP}}$ and $\beta_{113} P_{IMPLOG_{CHLP}}$, New Zealand's and Chile's softwood log substitute for America's softwood log. In the case of minus of signals of $\beta_{112}P_{IMPLOG_{NWP}}$ and $\beta_{113}P_{IMPLOG_{CHLP}}$, New Zealand's and Chile's softwood log compensate for America's softwood log.

The signal of the lagged endogenous variable $\beta_{114} IMPLOG_{AMEP}(-1)$ is to be plus. If America's softwood log import prices are high at a past period, saw log mills will buy in advance America's softwood logs. If America's softwood log import prices are low at a past period, log saw mills won't buy America's softwood logs in advance.

Signal of output $\beta_{115}PDT_{TLB}$ is to be plus. If quantities of output rise, America's softwood log demand will rise. Also if quantities of output decrease, America's softwood log demand will decrease.

2. New zealand's softwood log import demand model

$$IMPLOG_{NWP} = \gamma_{121} + \beta_{121}P_{IMPLOG_{NWP}} + \beta_{122}P_{IMPLOG_{AMEP}} + \beta_{123}P_{IMPLOG_{CHLP}} + \beta_{124}IMPLOG_{NWP}(-1) + \beta_{125}PDT_{TLB} + u_{12} \quad (7)$$

Signal of own log price $\beta_{121}P_{IMPLOG_{NWP}}$ is to be minus in eq. (7). That is, if New Zealand's softwood log import prices rise, New Zealand's softwood log import quantities will decrease. If New Zealand's softwood log import prices decrease, New Zealand's softwood log import quantities will rise. In the case of plus of signals of $\beta_{122}P_{IMPLOG_{AMEP}}$ and $\beta_{123}P_{IMPLOG_{CHLP}}$, America's and Chile's softwood logs substitute for New Zealand's softwood logs. In the case of minus of signals of $\beta_{122} P_{IMPLOG_{AMEP}}$ and $\beta_{123}P_{IMPLOG_{CHLP}}$, America's and Chile's softwood log compensate for New Zealand's softwood log. Explanations for signals of $\beta_{124}IMPLOG_{NWP}(-1)$ and $\beta_{125}PDT_{TLB}$ are identical with them for signals of $\beta_{114}IMPLOG_{AMEP}(-1)$ and $\beta_{115}PDT_{TLB}$ in eq. (6).

3. Chile's softwood log import demand model :

$$IMPLOG_{CHLP} = \gamma_{131} + \beta_{131}P_{IMPLOG_{CHLP}} + \beta_{132}P_{IMPLOG_{AMEP}} + \beta_{133}P_{IMPLOG_{NWP}} + \beta_{134}IMPLOG_{CHLP}(-1) + \beta_{135}PDT_{TLB} + u_{13} \quad (8)$$

Signal of own log price $\beta_{131}P_{IMPLOG_{CHLP}}$ is to be minus in eq. (8). That is, if Chile's softwood log import prices rise, Chile's softwood log import quantities will decrease. Also if Chile's softwood log import prices decrease, Chile's softwood log import quantities will rise. In the case of plus of signals of $\beta_{132}P_{IMPLOG_{AMEP}}$ and $\beta_{133}P_{IMPLOG_{NWP}}$, America's and New Zealand's softwood logs substitute for Chile's softwood logs. In the case of minus of signals of $\beta_{132}P_{IMPLOG_{AMEP}}$ and $\beta_{133}P_{IMPLOG_{AMEP}}$, America's and New Zealand's softwood logs compensate for Chile's softwood logs. Explanations for signals of $\beta_{134} IMPLOG_{CHLP}(-1)$ and $\beta_{135}PDT_{TLB}$ are identical with them for signals of $\beta_{114}IMPLOG_{AMEP}(-1)$ and $\beta_{115} PDT_{TLB}$ in eq. (6).

But eq. (6), (7) and (8) must satisfy simultaneously the homogeneous of degree 0 and the symmetric of conditional factor demand functions

$$\begin{pmatrix} \beta_{111}+\beta_{112}+\beta_{113}=0 \\ \beta_{121}+\beta_{122}+\beta_{123}=0 \\ \beta_{131}+\beta_{132}+\beta_{133}=0 \end{pmatrix} \cdots \text{homogeneous of degree 0} \quad (9)$$

$$\begin{pmatrix} \beta_{112}=\beta_{122} \\ \beta_{113}=\beta_{132} \\ \beta_{123}=\beta_{133} \end{pmatrix} \cdots\cdots \text{symmetric} \quad (10)$$

[Definitions of Variables]

$IMPLOG_{AMEP}$	America's softwood log import quantity
$IMPLOG_{NEP}$	New Zealand's softwood log import quantity
$IMPLOG_{CHLP}$	Chile's softwood log import quantity
$P_{IMPLOG_{AMEP}}$	America's softwood log import price
$P_{IMPLOG_{NWP}}$	New Zealand's softwood log import price
$P_{IMPLOG_{CHLP}}$	Chile's softwood log import price
$IMPLOG_{AMEP}(-1)$	America's softwood log demand lagged endogenous variable
$IMPLOG_{NWP}(-1)$	New Zealand's softwood log demand lagged endogenous variable
$IMPLOG_{CHLP}(-1)$	America's softwood log demand lagged endogenous variable
PDT_{TLB}	Total lumber output (America's lumber output + New Zealand's lumber output + Chile's lumber output)

Estimation Method

This study develops models by the production factor demand function. That is, because we won't examine situations where the demand in fact equals the supply, model development by estimation method of two-stage least squares (2SLS) or three-stage least squares (3SLS) isn't pertinent. In the case of the estimation of parameters of production factor demand equation, we can estimate briefly each equation with Ordinary Least Squares (OLS). But as the equations involve at least more than one identical factor in each equation, the regression disturbances in different equations are mutually correlated. Therefore in this case to estimate regression coefficients of each equation with OLS isn't pertinent. Each equation must satisfy simultaneously the properties of the conditional factor demand function[3] as follows: First, the factor demands are homogeneous of degree 0. Second, the cross-price effects are symmetric. Third, the own price effects are negative.

As above, the Seemingly Unrelated Regression Equations (SURE)[4] method being able to analyze simultaneously the three conditions of the conditional factor demand function will be used in this study. Larry (1981) analyzed market share rates for particleboard and southern pine plywood with SURE.

Long-run Elasticity

Based on Cagan's adaptive expectations model, softwood log import demand equations involving lagged endogenous variable from eq. (5) can be derived as

$$y_t = c_0 + c_1 y_{t-1} + c_2 x_t \tag{11}$$

Estimated long-run elasticity[5]

$$= \frac{\text{Estimated short run elasticity of } x_t}{1 - c_1} \tag{12}$$

Empirical Model and Estimation Results

The estimation results for America's, New Zealand's and Chile's softwood log import demand function are shown below. In the following discussion, the figures in parentheses are t-ratio, R^2 adjusted is R^2 adjusted for degree of freedom and Durbin-h is the Durbin-h statistic.

1. Form of America's softwood log import demand model was

$$\underset{}{IMPLOG_{AMEP}} = \underset{(6.50689)}{1{,}071{,}290} \underset{(-6.45345)}{-23{,}286 P_{IMPLOG_{AMEP}}} \underset{(2.84631)}{+6.031 P_{IMPLOG_{NWP}}}$$

$$\underset{(7.94922)}{+17.255 P_{IMPLOG_{CHLP}}} \underset{(7.80882)}{+0.591 IMPLOG_{AMEP}(-1)} \underset{(2.39395)}{+0.165 PDT_{TLB}} \tag{12}$$

$R^2_{Ajusted} = 0.86$

Durbin-h = 1.21

Sample period : 1981-1997

Estimation method : SURE

Table 1. Comparison of short-run and long-run elasticity of America's softwood log import demand.

Section	Short-run elasticity	Long-run elasticity
$E_{P_{IMPLOG_{AMEP}}}$	- 1.738	- 4.250
$E_{P_{IMPLOG_{NWP}}}$	0.264	0.646
$E_{P_{IMPLOG_{CHLP}}}$	0.782	0.912

Own price signal of America's softwood logs has the expected minus sign and satisfy production theory. America's softwood logs and New Zealand's softwood logs show a substitute relationship. Also, America's softwood logs and Chile's softwood logs show a substitute relation. All coefficients are statistically significant at the five per cent level. Durbin-h shows non-autocorrelation at a 5% significant level.

The short-run and long-run own-price elasticity of America's softwood log import demand are -1.738 and -4.250 respectively. Long-run elasticity is very much higher than short-run elasticity. But the short-run and long-run cross-elasticity of America's softwood log import demand with respect to New Zealand's softwood log import price are inelastic at 0.264 and 0.646 respectively. America's short-run cross-elasticity of softwood log import demand with respect to Chile's softwood log import price is inelastic at 0.737 but its long-run cross elastity is elastic at 1.912.

2. Form of new zealand's softwood log import demand model was

$$IMPLOG_{NWP} = \underset{(-8.13552)}{-832{,}665} \underset{(2.84631)}{+6.0308 P_{IMPLOG_{AMEP}}} \underset{(-6.97654)}{-20.5214 P_{IMPLOG_{NWP}}}$$

$$\underset{(4.79988)}{+14.4906 P_{IMPLOG_{CHLP}}} \underset{(6.97634)}{+0.4278 IMPLOG_{NWP}(-1)} \underset{(9.97730)}{+0.5233 PDT_{TLB}}$$

$$\underset{(2.71787)}{+241{,}140.928 DUM_{9597}} \tag{14}$$

$R^2_{Ajusted} = 0.99$

Durbin-h = 1.96

Sample period : 1981-1997

Estimation method : SURE

A dummy variable was included indicating some structural change occurred since 1995. A possible reason for the rapid increase of New Zealand's softwood log import was the adoption of a domestic softwood plywood production technique. The own price signal of New Zealand's softwood logs has the expected minus sign. New Zealand's softwood log and America's softwood

[3] Hal R. Varian, Microeconomic Analysis. Second Edition p. 52-57.
[4] J. Johnston, Econometric Methods Third Edition p. 350.
[5] Kmanta, J., Element of Econometric. p. 635-648.

Table 2. Comparison of short-run and long-run elasticity of New Zealand's softwood log import demand.

Section	Short-run elasticity	Long-run elasticity
$E_{P_{IMPLOG_{AMEP}}}$	0.505	0.883
$E_{P_{IMPLOG_{NWP}}}$	-1.009	-1.764
$E_{P_{IMPLOG_{CHLP}}}$	0.737	1.288

logs showed a substitute relation. Also, New Zealand's softwood logs and Chile's softwood logs show a substitute relation. All coefficients are statistically significant at a five percent significant level. The coefficient of adjusted determination R^2 is very high at 0.99. Because the durbin-h statistic is 1.96, it is difficult to conclude that autocorrelation is or not at a 5% significant level.

Short-run and long-run elasticity of New Zealand's softwood log import demand with respect to the own price are -1.009 and -1.764 respectively. Short-run elasticity is unit elastic at -1.009 and long-run elasticity is elastic at -1.764. Short-run and long-run cross-elasticity of New Zealand's softwood log import demand with respect to American's softwood log import price are inelastic at 0.505 and 0.883 respectively. Short-run cross-elasticity of New Zealand's softwood log import demand with respect to Chile's softwood log import price is inelastic at 0.737 but its long-run cross elasticity is elastic at 1.288.

3. Form of chile's softwood log import demand model was

$$\underset{}{IMPLOG_{CHLP}} = \underset{(-4.14663)}{-244,303} + \underset{(7.94922)}{17.2550}P_{IMPLOG_{AMEP}} + \underset{(4.79988)}{14.4906}P_{IMPLOG_{NWP}}$$

$$- \underset{(-8.05083)}{0.4528}P_{IMPLOG_{CHLP}} + \underset{(5.75671)}{0.4528}IMPLOG_{CHLP}(-1) + \underset{(0.13919)}{0.0345}PDT_{TLB} \quad (15)$$

$R^2_{Ajusted}$ = 0.95
Durbin-h = -0.76
Sample period : 1981-1997
Estimation method : SURE

Own price signal of Chile's softwood log has the expected minus sign. Chile's softwood log and America's softwood log show a substitute relationship. Also Chile's softwood logs and New Zealand's softwood logs show a substitute relation. All coefficient estimates except for output are statistically significant at the five percent level. The Durbin-h statistic shows non-autocorrelation at a 5% significant level.

Table 3. Comparison of short-run and long-run elasticity of Chile's softwood log import demand.

section	Short-run elasticity	Long-run elasticity
$E_{P_{IMPLOG_{AMEP}}}$	2.442	4.462
$E_{P_{IMPLOG_{NWP}}}$	1.204	2.200
$E_{P_{IMPLOG_{CHLP}}}$	-2.728	-4.986

Short-run and long-run elasticity of Chile's softwood log import demand with respect to own price are -2.728 and -4.986 respectively. Long-run elasticity is almost twice as high as short-run elasticity.

Short-run and long-run cross-elasticity of Chile's softwood log import demand with respect to American's softwood log import price are highly elastic at 2.442 and 4.462 respectively. Long-run elasticity is almost twice as high as short-run elasticity. Short-run cross-elasticity of Chile's softwood log import demand with respect to New Zealand's softwood log import price are almost unit elastic at 1.204 but long-run cross-elasticity is highly elastic at 2.200.

And eq. (13), (14), and (15) satisfy simultaneously the restrictions that the derivatives of the cost function are homogeneous of degree zero in price and the cross-price effects are symmetric and the own price effects are negative.

(Park and Youn 2001) developed models under the assumption that volumes of imported softwood logs are affected by only softwood logs import price in the current year.

But in this study models developed under the assumption that volumes of imported softwood logs in the current year is affected by not only imported softwood logs' import price and volumes of output in the current year but also softwood log's import price and volumes of output in the previous year are more efficient than models developed by (Park and Youn 2001).

And this study represents that volumes of softwood log imports in the current year are affected by not only softwood log's import price in the current year but also softwood logs import price in the previous year.

Conclusions

To examine that volumes of softwood logs import in the current year is affected by not only softwood logs import price and volumes of output in the current year but also softwood logs import price and volumes of output in previous year, forms of softwood log import demand models were developed with emphasis on the country's softwood log import markets. The major results obtained from the estimated models are as follows:

Short-run and long-run elasticity of America's softwood log import demand with respect to the own price are -1.738 and -4.250 respectively. Long-run elasticity is very higher than short-run elasticity.

But short-run and long-run cross-elasticity of America's softwood log import demand with respect to New Zealand's softwood log import price are inelastic at 0.264 and 0.646 respectively. Short-run cross-elasticity of America's softwood log import demand with respect to Chile's softwood log import price is inelastic at 0.737 but its long-run cross elasticity is elastic at 1.912.

Short-run and long-run elasticity of New Zealand's softwood log import demand with respect to the own price are -1.009 and -1.764 respectively. Short-run elasticity is unit elastic at -1.009, but long-run elasticity is elastic at -1.764.

Short-run and long-run cross-elasticity of New Zealand's softwood log import demand with respect to America's softwood log import price are inelastic at 0.505 and 0.883 respectively.

Short-run cross-elasticity of New Zealand's softwood log import demand with respect to Chile's softwood log import price is inelastic at 0.737 but its long-run cross elasticity is elastic at 1.288. Short-run and long-run elasticity of Chile's softwood log import demand with respect to the own price are -2.728 and -4.986 respectively. Long-run elasticity is almost twice as high as short-run elasticity.

Short-run and long-run cross-elasticity of Chile's softwood log import demand with respect to America's softwood log import price are highly elastic at 2.442 and 4.462 respectively. Long-run elasticity is almost twice as high as short-run elasticity.

Short-run and long-run cross-elasticity of Chile's softwood log import demand with respect to New Zealand's softwood log import price are highly elastic at 1.204 and 2.200 respectively. Long-run elasticity is almost twice as high as short-run elasticity.

Just as before, we find that Long-run elasticity is higher than short-run elasticity in all form of models. That is, we can find that volumes of imported softwood log in the current year is affected by not only imported softwood log's price in the current year but also the imported softwood log price in the previous year

Properties of the softwood log import market analysis in this study are as follows :

First, using the conditional factor demand function derived from cost function, the models were developed. Especially the models were estimated by the Seemingly Unrelated Regression Equation (SURE) being able to satisfy the properties of conditional factor demand functions.

Second, because softwood log import demand equations were connected mutually by the same softwood log import price, the disturbance in a log import demand equation could be correlated with the disturbance in some other log import demand equation. Therefore, each model was estimated simultaneously by Seemingly Unrelated Regressions (SUR) and the efficiency of each model was high.

Third, the substitute relation between America's softwood logs and New Zealand's softwood logs or between America's softwood logs and Chile's softwood logs or between New Zealand's softwood logs and Chile's softwood logs can be measured by the estimate method of SURE.

Forth, short-run and long-run cross-elasticity of models developed in this study can be used as an important means of determining log import volumes.

The Models adopted in this study couldn't explain enough wood (lumber, processed wood, etc.) import except for log import. That is the model cannot explain the import change of softwood log volume due to import changes of processed softwood wood volume Therefore, the import relations between wood and logs by the technical, social, political and other changes in the model should be further investigated for future study.

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