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ISBN 0-315-55509-2

THE UNIVERSITY OF ALBERTA

Trade Barriers and the Japanese Forest Products Trade and Markets

by

CLARITA M. YLAGAN

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE

IN

FOREST ECONOMICS

DEPARTMENT OF RURAL ECONOMY

EDMONTON, ALBERTA

FALL 1989

THE UNIVERSITY OF ALBERTA

RELEASE FORM

NAME OF AUTHOR CLARITA M. YLAGAN

TITLE OF THESIS Trade Barriers And The Japanese Forest Products Trade And Markets.

DEGREE FOR WHICH THIS THESIS WAS PRESENTED Master of Science

YEAR THIS DEGREE WAS GRANTED Fall 1989

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled TRADE BARRIERS AND THE JAPANESE FOREST PRODUCTS TRADE AND MARKETS submitted by CLARITA M. YLAGAN in partial fulfilment of the requirements for the degree of MASTER OF SCIENCE in FOREST ECONOMICS.

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Supervisor

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Date 29 Sept 1989

DEDICATION

This thesis is lovingly dedicated to

my mother, Imelda and my son, Joseph.

ABSTRACT

This study focuses on the Japanese forest products trade and markets. A computable trade model was constructed to analyze the economic and distributional effects of decreasing the import tariff on processed products by Japan and increasing the export tax on hardwood logs by both Malaysia and the Philippines and by each country individually. The model incorporated the Armington effect, allowing for substitution between hardwood and softwood products from different countries of production in the Japanese market. It employed process modeling, cost and pricing relationships and product and factor market equilibrium conditions. Simulation runs of the model yield interregional trade flows and pricing at multiple market levels and regional factor employment rates.

Results of the study showed that a reduction in tariffs on processed products increases trade flow and supply prices of imported forest products to Japan while decreasing Japanese domestic forest products trade and supply prices. Capital and land employment, returns to capital and land, and profitability in the exporting countries increase while those of Japan decrease. Increasing the export tax on hardwood logs by both Malaysia and/or the Philippines decreases trade of hardwood logs, increases trade flow of hardwood processed forest products and decreases supply prices of hardwood forest products from the log export tax imposing countries. Also, capital employment, returns to capital

and profitability increase in the hardwood processed forest products sector while decreasing in the hardwood log sector as in the case of land employment and returns to land. Japanese domestic hardwood processed forest products sector also suffers decreases in output, capital employment and returns to capital. On the other hand the Japanese domestic softwood sector experiences gains together with the North American softwood forest products suppliers. A log export tax increase has more pronounced effects on the market if it is imposed by both Malaysia and the Philippines or by Malaysia alone.

Based on national income gains, it can be said that exporting countries should vigorously lobby for trade liberalization in Japan. Alternatively, the developing Asian countries, can use export taxes in hardwood logs to benefit their processed products sector but at the expense of their hardwood log sector.

ACKNOWLEDGEMENTS

I wish to thank Luis Constantino, my supervisor, for the encouragement, assistance and direction he had given me during my graduate studies.

I would also like to thank Mike Percy for helping me during my frustrating moments. His excellent knowledge of economics and expertise in CGE saved this thesis. I am forever grateful to him

Also, I want to acknowledge Bill Phillips for his constant support and advice throughout my studies. I am also grateful to Terry Veeman and Martin Luckert for their valuable comments on this thesis.

For their assistance and advice, I thank the staff and graduate students of the Department of Rural Economy. Special thanks go to Kelly, Wendy C., Wendy W., Barb and Hildegard for their concern.

My deepest gratitude goes to my bosom friend, Mary Ann, for her unlimited assistance and moral support. I am also forever indebted to my sister, Agnes, for collaborating with me so I can pursue my goals.

Moreover, I want to thank my husband, Miel, for his encouragement and support; the other members of my family for their assistance and prayers; and my friends for making my graduate student days memorable.

Finally, I thank God for making all of these possible.

Table of Contents

List of Tables

List of Figures

I. INTRODUCTION

Over the past decade, Japan has evolved into one of the world's largest markets for forest products. During the period 1975-85, it imported an average of 13 percent of the world's total import value of forest products while only exporting an average of less than two percent of the world's total export value of forest products (Fig 1.1). Its import value share is the second largest (next to the United States) in the world. Thus, it is necessary to identify and assess opportunities for increasing trade into the region.

The Japanese market for forest products is characterized by various trade distortions. On the demand side, Japan places tariffs on processed forest product imports. On the supply side, exporting countries, particularly Malaysia and the Philippines, place an export tax on uprocessed log exports to Japan.

The potential gains to these countries from imposing these restrictions stem from the so-called optimal tariff theory where importers and exporters take advantage of the less than perfectly elastic supply and demand functions facing them.[1] It is possible to tax imports or exports so that foreign suppliers or demanders

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[1] This is an application of monopoly theory. The basic idea is that a country concerned solely with its national interest restricts its trade so as to exploit its potential monopoly or monopsony power. Hence, in processed forest products trade, Japan is assumed to be "large" and in unprocessed hardwood log trade, Malaysia (and the Philippines) is assumed to be "large" - to be able to influence market prices.

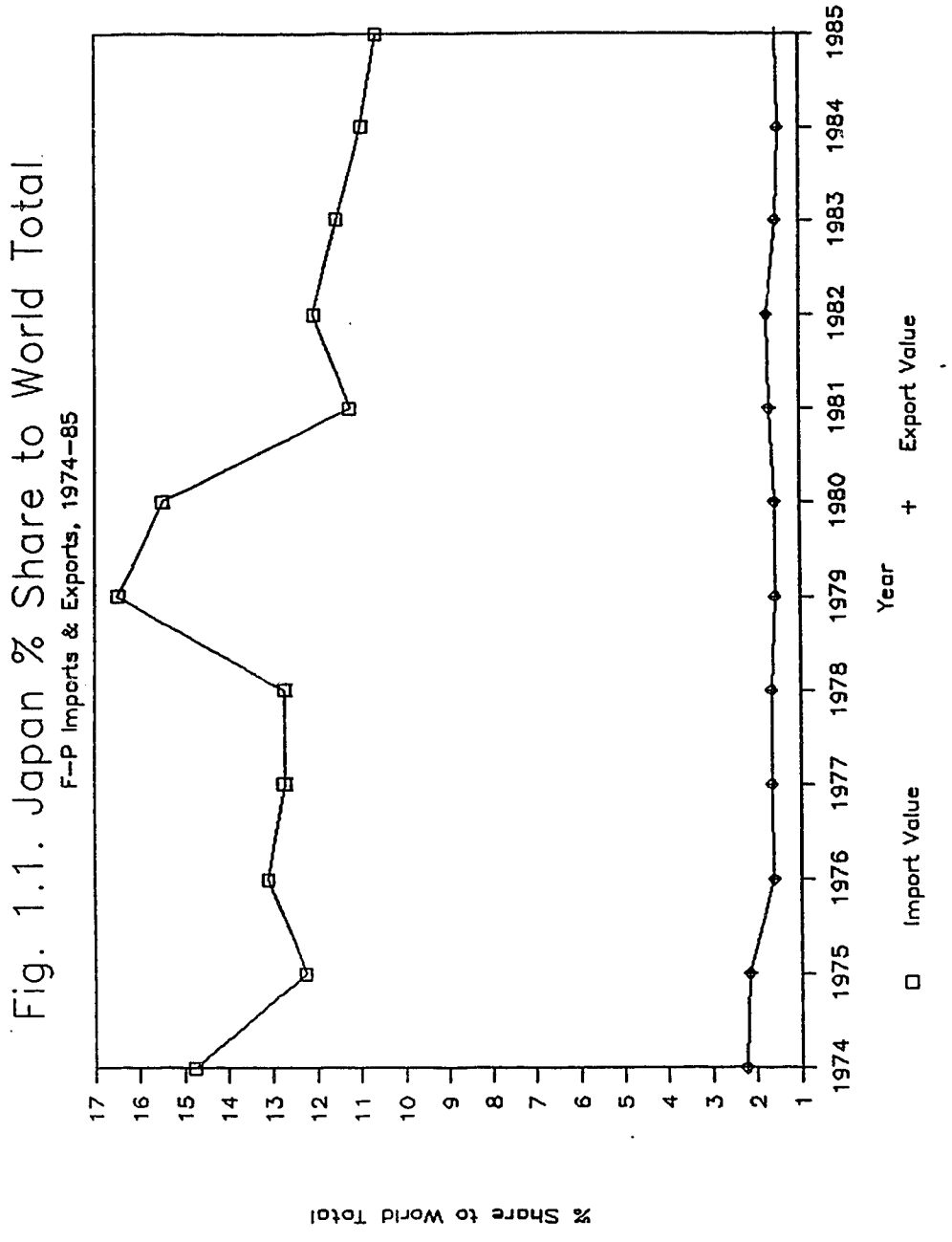
Fig. 1.1. Japan % Share to World Total
F-P Imports & Exports, 1974-85
% Share to World Total
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
Year
Import Value
Export Value

pay some of the tax. In this way, the national income of the buyer or seller nation increases relative to free trade position.

With the increasing concern towards global welfare, particularly the income disparity between rich and poor countries, international trade negotiations have been made to reduce tariff barriers in developed countries.[2] In spite of several rounds of tariff negotiations, tariffs that face imports of forest products into Japan remain relatively high. Considering the adverse effects of tariffs on processed forest products exports of exporters, further reduction or elimination of tariffs on processed forest products imports by Japan may prove beneficial to its exporters, particularly to the developing countries of Indonesia, Malaysia and the Philippines.

On the other hand, developing countries are allowed to use trade restrictions for development objectives. It is then of interest how increases in export tax on hardwood log exports to Japan by Malaysia and the Philippines contribute to these objectives.

Previous studies on the extent by which these duties affect development objectives, particularly increased production and

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[2]Concluded in 1979 was the Tokyo Round of Multilateral Trade Negotiations where one of the stated goals was to reduce tariff escalation in order to facilitate expansion of developing countries' exports of manufactures (Olechowski, 1987).Presently being held is the Uruguay Round wherein one of the proposals being discussed is the elimination of tariffs (See "GATT talks stall on disputed world", *Globe and Mail*, Dec. 1988).

trade, are lacking in detail.[3] In particular, the economic efficiency and the distribution of the gains and losses to different sectors of the trade participating countries were not examined. In this study, the interdependencies of the changes in these duties among different competing supplying countries and among different sectors of the forest products industry are incorporated. Specifically, this study captures the presumed effects of trade policy changes on economic variables and their income distribution to the different sectors of the trade participating counties. Given this information, policy makers can control economic variables and their distributional consequences to different sectors and countries by prescribing the change in the trade policy variable that is necessary to effect such changes.

It is also necessary to assess how trade distortions in some commodities, such as tropical hardwood logs, affect related markets, such as the ones for softwood products. The substitution possibilities that exist between softwood and hardwood products in the Japanese market suggest the interdependence of impacts of

---

[3]See for example, Olechowski, 1987. In here the amount of trade lost due to the existence of tariffs was quantified for all of wood and wood products from developing countries, together with those from developed market economy and socialist countries. However, no breakdown of the loss was quantified for each exporter nor for each forest product. In another study, Klein and Hackett (1985) quantified the increase in trade that would result from a tariff removal in Japan. Likewise, no disaggregation of the gain per exporter and per forest product was made. In both studies the effects of tariff removals on other economic variables such as prices were not quantified. Further, the gains or losses from export taxes were not measured.

trade restrictions between hardwood and softwood products. To evaluate this interdependence is particularly important for North American suppliers who want to increase their market shares in hardwood dominated Japanese forest product markets. Most existing trade models have not taken this into consideration.[4] Recently, however, this substitution between softwood and hardwood products has been incorporated by Constantino (1988) in his trade model of the Indonesian wood products market.

A. Objectives of the Study

This study then focuses on some trade policy issues and attempts to quantify the economic effects of such policies. The issues addressed are:

1. The effects of tariffs on the forest products production and trade of both Japan and its import supplying countries;
2. The effects of an export tax on logs on the processed product production and trade of both Japan and the import supplying countries;
3. The effects of trade policies on factors of production in the forest products industries of both Japan and its import supplying countries; and

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[4]Trade models on Japanese forest products have not considered both hardwood and softwood commodity classifications of forest products.For example, Vincent's (1987) work modeled only the Japanese-Southeast Asian trade on tropical hardwood products. Another study (Nomura and Yukutake, 1982) developed a model of aggregate log and aggregate lumber trade between Japan and foreign countries.

4. The effects of trade policies on the national income of both Japan and its import supplying countries.

Specifically, the following questions are asked:

1. How do decreases in tariffs in plywood and sawnwood imports by Japan affect domestic production and imports of plywood and sawnwood in Japan?
2. Can an increase in export tax in unprocessed hardwood logs bring a corresponding increase in exports of processed hardwood forest products from the exporting countries or will this result in a loss of market share to substitute products and/or competing exporters?
3. How do product and factor prices as well as employment respond to changes in trade policies?
4. How do the national incomes of Japan and its import supplying countries change with the change in trade policy?

This study concludes with an outline of particular trade strategies that will be beneficial to either or both Japan and its forest products supplying countries.

B. Study Outline

The following outlines the main chapters of the study. Chapter 2 contains an analysis of trade flows and restrictions in the Japanese market for forest products in order to identify the important economic and trade policy variables that exist and their interrelationships. An overview of the approaches to modeling forest products trade and trade in general is contained in chapter

3 with the end view of identifying the best approach for the analysis of the issues addressed earlier. Chapter 4 contains the model chosen in terms of its theoretical underpinnings and practical implementation. Chapter 5 contains the results of various economic and policy interventions. The last chapter concludes with a discussion of the lessons learned from the modeling exercise and some recommendations for future research.

II. THE JAPANESE FOREST PRODUCTS TRADE AND MARKET TRENDS

This chapter discusses the Japanese market for forest products in terms of the structure and trends on both the demand and supply side. Structure and trends on the supply side are discussed with respect to both the domestic and the imported timber supply. The export supply side of the exporting countries is also presented. A discussion on the trade restrictions that exist in the Japanese market ends the chapter.

A. Forest Products Demand

In Japan, timber products are generally used by the construction and furniture industries and as such, the demand for these is primarily influenced by the growth in the national economy, as expressed in national income. Over the years, however, there has been a gradual decrease in the demand for forest products despite the growing national economy.

Aside from macro variables, other micro factors affect Japanese demand. In particular, Japanese preference for straight grain and uniform texture panelling add to the popularity of using hardwood from Southeast Asia for plywood. Consequently, 70 percent of the hardwood logs imported from Southeast Asia were used for plywood and veneer production. In comparison, 99 percent of the hardwood logs imported from North America and 97 percent of those from Soviet Union were used for lumber production (Scott, et al.; 1986). These pieces of evidences point to the fact that forest

product goods are differentiated in the Japanese market with respect to their source of origin.

B. Forest Products Supply

It has been projected that Japan's domestic timber production will increase.[5] This projection has been criticized on several grounds. Among the reasons cited are poor inventory structure, high harvesting costs, low import prices, labour constraints, inadequate road system and conservation concerns in Japan (Klein and Hackett, 1985). Also cited is the competition domestic timber faces with North American timber which is a direct rival for the same end uses (Nomura, 1986). It can then be inferred that the Japanese timber demand will continue to be dominated by imported timber.

The supply of imported timber like that of domestic timber, has fluctuated during the period 1975-85 (Fig 2.1). With respect to commodity composition, Fig 2.2 and 2.3 show that Japan's largest imports during the period consisted of hardwood and softwood logs, followed by hardwood and softwood sawnwood, and finally by plywood.[6] As the period progressed, the share of

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[5]One of the projections in 1980 predicts that the share of domestic timber to the total timber supply will increase from 46.2 percent in 1986 to 57.7 percent in 1996. See I. Nomura (1986), Table 1, p.58.

[6]FAO and UN publications do not distinguish between hardwood and softwood plywood in reporting production and trade statistics.

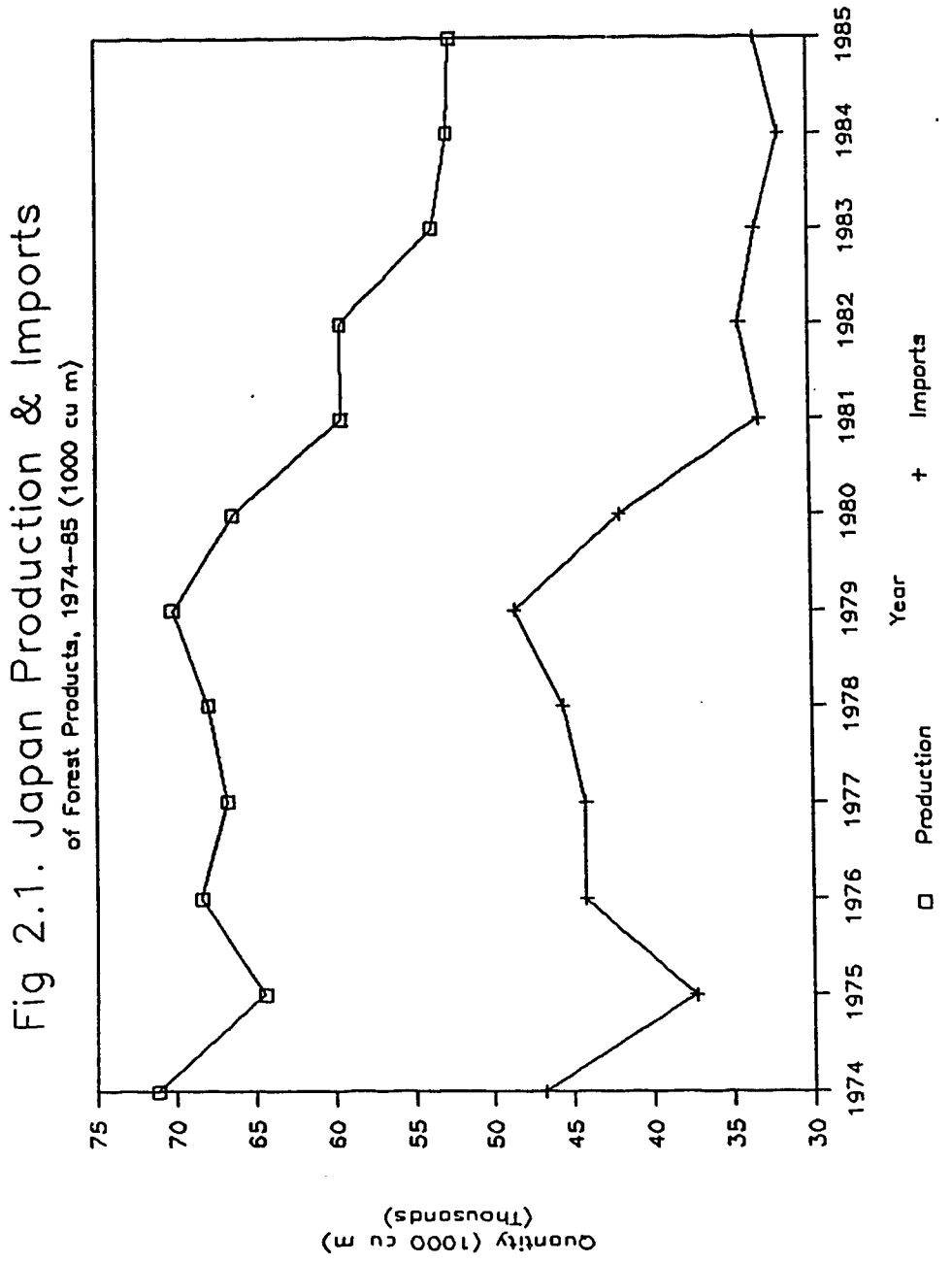


Fig 2.1. Japan Production & Imports
of Forest Products, 1974-85 (1000 cu m)
Quantity (1000 cu m)
(Thousands)
75
70
65
60
55
50
45
40
35
30
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
Year
□ Production
+ Imports

Fig 2.2. % Share of Japan's F-P Imports by Commodity, 1974

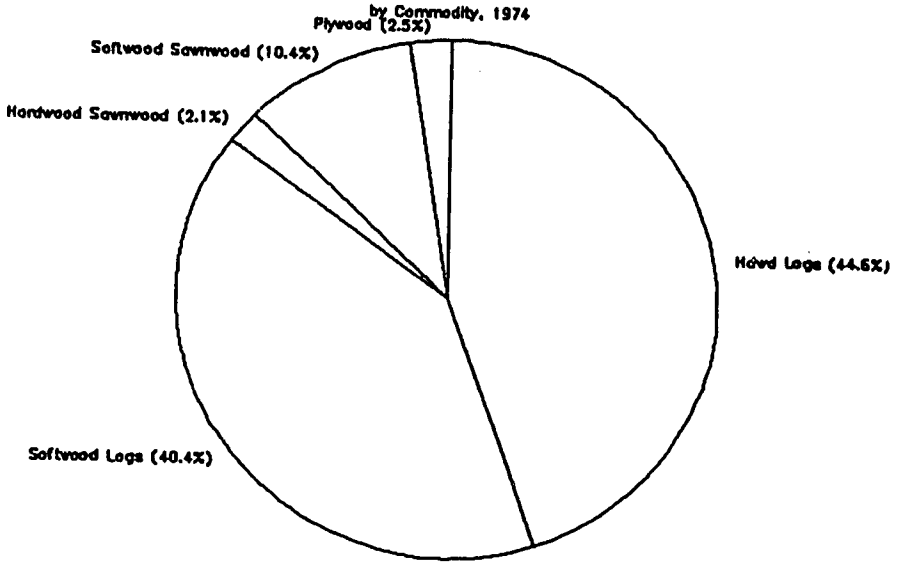
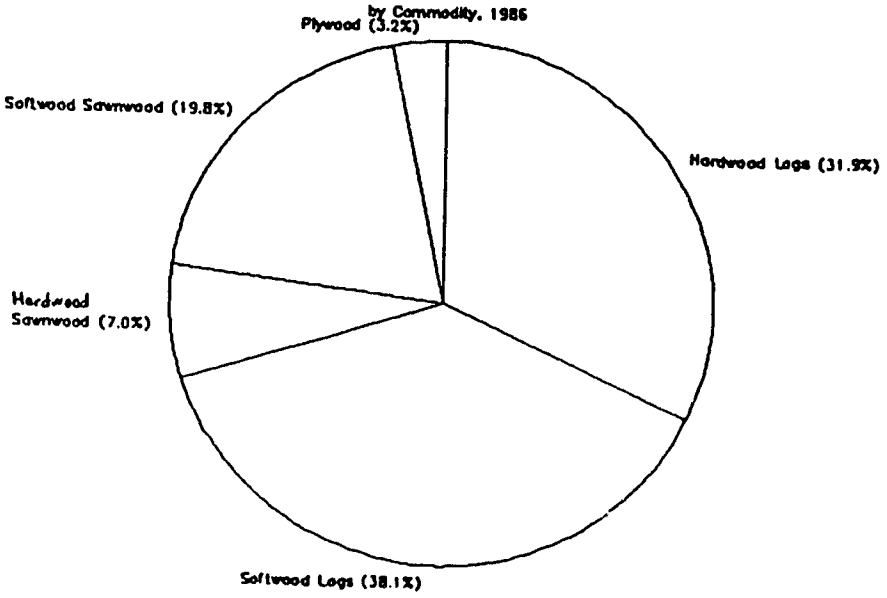


Fig 2.3. % Share of Japan's F-P Imports by Commodity, 1986



hardwood logs fell while that of hardwood sawnwood rose. Softwood sawlog's share had decreased while softwood sawnwood's share had almost doubled from 10.4 percent in 1974 to 19.8 percent in 1986. On the other hand, plywood's share had remained consistently low during the period but had increased slightly in 1986.

Some changes can also be observed in the percentage change in the share to the total value of imports in Japan by source of origin. Examination by country in Fig 2.4 and Fig 2.5 shows that there had been a large downward trend in imports of all forest products in general coming from Indonesia and the Philippines, while there was a corresponding upward trend in the imports coming from Malaysia and Canada. Those from the U.S. and other countries had relatively minor changes. These trade patterns corroborate the trade inertia findings of Kornai (1986).[7] It was found out that the inertia multipliers for the exporting countries, Malaysia and Canada were increasing over time whereas those of Indonesia and the Philippines were decreasing over time and all those of the U.S. and all the exporters in general, showed a relatively strong inertia (i. e. just above unity).

Moreover, Table 2.1 shows that for a particular country, no consistent upward or downward trend in the percentage changes in

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[7]Kornai (1986) defines trade inertia as the "extent to which the historical patterns of trade prevail over time". It is measured in terms of an inertia multiplier which increases monotonically as the time lag increases with a positive trend in the development of a given trade flow. Conversely, it decreases monotonically as the time lag increases with a negative trend in the development of a given trade flow.

Fig 2.4. % Share of For Prod Imports
of Japan by Country, 1974

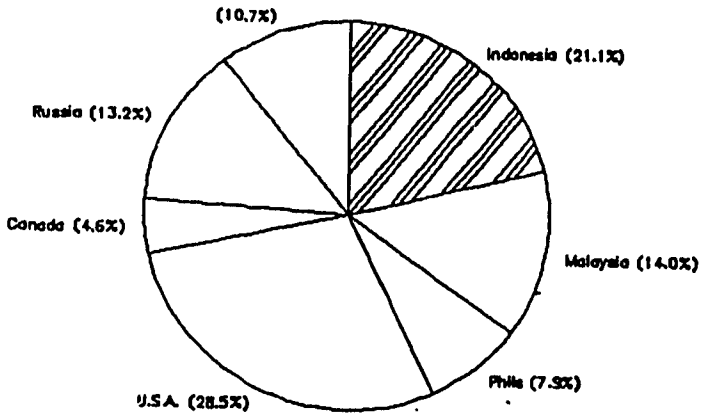
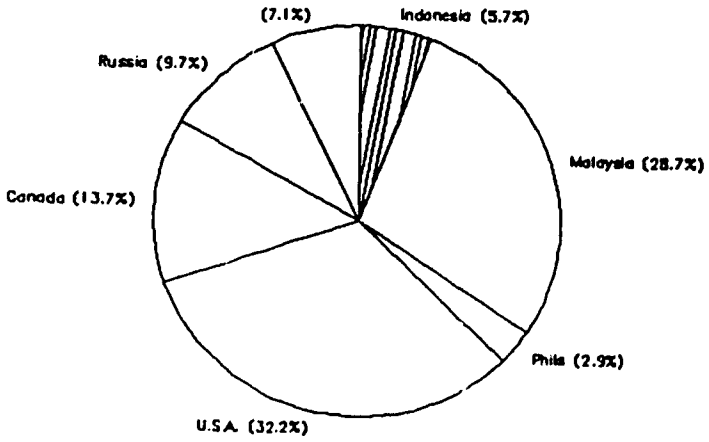


Fig 2.5. % Share of For Prod Imports
of Japan by Country, 1985



v^{ij}= rental charge of land in product i in country j

p^{ji}= price of intermediate input

p^{e}_{ij} = producer price of product i in country j.

Equilibrium also requires that factor demand should equal factor supply. Thus:

(8) $C^{ij}_{r}(w^{j}, r^{ij}, v^{ij}, p^{ji})\, x_{ij} = k^{ij}$

(9) $C^{ij}_{v}(w^{j}, r^{ij}, v^{ij}, p^{ji})\, x_{ij} = l^{ij}$

The aggregate demand for the intermediate products, logs, in the secondary wood processing industries is derived using a fixed coefficient or Leontief production function.[17] The aggregate demand for logs is represented as:

(10) $x_{ji} = \Sigma\, (r_i)^{-1} x_{ij}$

where:

x_{ji} = input demand for logs from country j for product i in the log importing country

r_i = estimated log recovery rate in the production of product i in the log importing country

x_{ij} = product output i in the importing country j.

This equation ensures that the log markets clear, i.e., the demand for logs equals the sum of the intermediate uses of secondary wood processing firms in the importing country.

Factor Supplies

The primary factor supplies in the producing countries are

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[17]See Adams (1985).

defined by a rather ad hoc function of factor prices (departing from Armington).[18] as:

(11) $k^{ij} = (r^{ij})^{\alpha_{rj}}$

(12) $l^{ij} = (v^{ij})^{\alpha_{vj}}$

where:

α_{rj} = supply elasticity of capital with respect to rent in producing country j

α_{vj} = supply elasticity of land with respect to rent in producing country j.

Export Supply Function of Softwood Products

Export supply functions of softwood products from the U.S.A and Canada were defined as ad hoc functions of prices in Japan:

(13) $x_{ij} = (p_{ij})^{\gamma_{ij}}$

where:

x_{ij} = export supply of softwood product i from exporting country j to Japan

p_{ij} = price of softwood product i from exporting country j in Japan

γ_{ij} = elasticity of export supply of softwood product i from country j with respect to the import price in Japan

B. Implementation of the Model

This section will deal with how the above theoretical model is

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[18] See Sarris (1983) and Percy (1986).

implemented with respect to the existing structure of production and trade in the Japanese market for forest products. The data and parameters of the model will be identified in terms of the trade participants and the sectors involved. Finally, the algorithm and the software used will be described.

Model Structure

Since each industry has both softwood and hardwood goods available, the choice between the type of goods is first characterized. This is done for each industry through functions that aggregate the services of hardwood and softwood goods. These functions are specified as constant elasticity of substitution (CES) functions. Given the aggregate demand functions for hardwood and softwood goods, the next choice is the source of origin of each.

Demanders differentiate between home produced and imported products. Additionally, imports from different countries are also imperfect substitutes. Thus demands for imports from each of the exporting countries and home produced goods are separate, but depend on the prices of all good according to Armington theory.

Producers, too, are assumed to distinguish between goods produced domestically and those that are exported. Thus within each country and industry, producers are separated into a home sector and an export sector. Each has its own supply function, reflecting certain fixed factors of production that can not be easily transferred between the sectors. Since the interest here is

only on interregional trade between Japan and its import suppliers, only the export sector of the exporting countries (Indonesia, Malaysia, Philippines, United States and Canada) to Japan and the domestic sector of Japan are considered in modeling the forest products production and trade in Japan.

Three separate prices are obtained for each industry in the Japanese market. First, a home price is paid by users and received by producers in the home sector. It is determined by equating the unit cost with producer price (sector supply equals demand). The second set of prices are those paid for imports from different exporting countries. These are obtained as proportions of the export prices which are derived in the exporting countries by equating the unit cost with producer price. All countries face a common aggregate price in each industry which is the third set of prices. This is determined in the Japanese market through the interaction of domestic and import prices.

The focus of the model is on the forest products trade between Japan and the Asian and North American import supplying countries. The Asian countries consist of Indonesia, Malaysia, and the Philippines while the North American counties consist of the United States and Canada. The model includes six sectors or industries, namely, hardwood log, softwood log, hardwood sawnwood, softwood sawnwood, hardwood plywood and softwood plywood. Specifically, the model concentrates on domestic markets in Japan and import markets in Japan in the context of the import supplying countries to Japan. Thus for Japan, domestic production and trade

in hardwood and softwood log, hardwood and softwood sawnwood and hardwood and softwood plywood are considered. For the Asian countries, export production and trade to Japan are considered in hardwood logs (except for Indonesia where there is a current log export ban), sawnwood and plywood. Finally, for North American countries, export trade to Japan are considered in softwood logs, sawnwood and plywood.

Data and Parameters

The model consists of 6 aggregate demand functions for hardwood and softwood logs, sawnwood and plywood in Japan together with 4 each of country demands for hardwood plywood and sawnwood and 2 country demands for hardwood logs; and 3 each of country demands for softwood plywood, sawnwood and logs. Corresponding to each of the demand functions are 19 aggregate and import price functions. Factor supply and demand equations for capital and land in forest products production in Japan, Indonesia, Malaysia and the Philippines comprise 32 equations. Cost functions of the hardwood forest products in exporting countries constitute 8 equations, cost functions of hardwood and softwood products in Japan make up 6, and export supply functions of softwood forest products form U.S.A. and Canada make up another 6 equations.

With seven countries and six industries, a total of 96 endogenous and 15 exogenous variables is found to explain and describe the existing market and trade in the Japanese forest products market. The endogenous variables are 25 trade flows, 20

import prices, 19 supply prices, 16 factor returns and 16 factor employment levels. The major exogenous variables are demand shifters (income variables) and trade shifters (tariffs and export taxes).

In general, the coefficients of the explanatory variables that appear in the model are:

1. Calculated from production, trade and employment data by industry in each country. These data are found in published statistics documents particularly the U.N. Commodity Yearbook and the FAO Forest Products Yearbook;
2. Obtained from relevant published and unpublished estimates of demand substitution and supply elasticities and cost shares; and
3. Derived by the author.

The details of these parameter values are presented in Appendix B.

Solution Procedure

Given appropriate data and parameter estimates for countries and industries noted, a system of linear equations is constructed from the equations of the model which are in the rate of change format. The coefficients in each of the linear equations are evaluated using the data and elasticity information collected. This system of linear equations is rearranged so that all the endogenous variables appear on the left hand side and all the exogenous variables, on the right hand side. This procedure yields a matrix expression of the form $Ax = B$, where A is the matrix of

parameters and elasticities, x is a vector of endogenous variables (prices and quantities), and B is a vector of exogenous variables. The model is then solved for x by simple matrix inversion, i.e., $x = A^{-1}B$. The values of x obtained represent the percent change in endogenous variable that is required to obtain a new equilibrium given the exogenous shock or change in an exogenous policy or trade variable.

The matrices of the coefficients of endogenous and exogenous variables are initially generated using FORTRAN. The matrix of coefficients of endogenous variables is inverted using Shazam. The inverted matrix is multiplied with the column vector of the coefficients of the desired exogenous matrix using Shazam. This procedure yields a series of a 96 X 1 solutions of the percent change in the endogenous variable with respect to a one percent change in the respective exogenous variable.

Scenario Analysis

The most important shifters for the purposes of this study are the trade shifters that appear in the price equations. Changes in tariffs and export taxes are introduced directly through the price equations to determine their effects on the 96 endogenous variables. This study is concerned with trade flows, supply prices, returns to capital and land, levels of capital and land employment, and profitability in each industry and country and how they are affected by the following scenarios:

1. Decreasing the import tariff on all plywood and sawnwood imports by

Japan; and

2. Increasing the export tax on hardwood logs simultaneously by Malaysia and the Philippines;
3. Increasing the export tax on hardwood logs by Malaysia alone; and
4. Increasing the export tax on hardwood logs by the Philippines alone.

Policy scenario 1 is in line with the reductions in international trade barriers negotiated under the General Agreement on Tariffs and Trade and answers the question of how import tariff reductions in processed products by Japan affect its domestic production. Policy scenarios 2, 3, and 4 are in line with allowing developing countries to use trade restrictions for balance of payment and development objectives. The substitution of processed products for log exports by developing countries and the competitiveness of products from these countries with respect to Japanese and North American products are explored in this scenario analysis.

V. RESULTS AND DISCUSSION

This chapter presents and discusses the results of the simulation runs of the model. Four scenarios are presented, namely; decreasing the import tariff on processed products by Japan (Scenario 1), increasing the export tax on hardwood logs by both Malaysia and the Philippines (Scenario 2), increasing the export tax on hardwood logs by Malaysia alone (Scenario 3) and increasing the export tax on hardwood logs by the Philippines alone (Scenario 4).

All of the above changes in tariffs and export taxes are by 1 percent change and the results obtained are all in percent changes in the endogenous variables in the model. Absolute changes in variables can be determined by multiplying the percent changes with the initial 1986 levels taken as the reference point for all calculations. Also, the model is basically short run in perspective because capital stock is fixed. There is not much response with respect to increases in capital stock in the sector by reallocating capital among industries. Capital is treated as being inelastic to rental rate. The magnitude of the elasticity of capital (0.10) reflects primarily changes in capacity utilization.

A. Scenario 1

Tables 5.1 to 5.3 show the effects of decreasing by 1 percent the ad valorem import tariff on all processed forest products by Japan. Table 5.1 shows the effect on trade flow and supply price

Table 5.1. Effect on Trade Flow (TF) and Supply Price (SP) of Forest Products in Japan of a 1% Decrease in Ad Valorem Import Tariff on Processed Products by Japan (% Change)

	Forest Product					
	Hdwd Plywood		Hdwd Sawnwood		Hdwd Log	
Country	TF	SP	TF	SP	TF	SP
Indonesia	0.62	0.19	0.11	0.01		
Malaysia	0.41	0.09	0.06	0.02	0.08	0.07
Philippines	0.41	0.09	0.07	0.02	0.04	0.07
Japan	-0.02	-0.10	0.07	-0.09		
	Sfwd Plywood		Sfwd Sawnwood		Sfwd Log	
Country	TF	SP	TF	SP	TF	SP
U.S.A.	0.20	0.25	0.01	0.02	-0.41	-0.41
Canada	0.20	0.25	0.01	0.04	-0.41	-0.71
Japan	-0.15	-0.07	-0.06	-0.03	-0.34	-0.14

Table 5.2. Effect on Capital Employment (K) and Returns to Capital (r) in Forest Products of a 1% Decrease in Ad Valorem Import Tariff on Processed Products by Japan (% Change)

	Forest Product					
	Hdwd Plywood		Hdwd Sawnwood		Hdwd Log	
Country	K	r	K	r	K	r
Indonesia	0.06	0.06	0.01	0.01		
Malaysia	0.04	0.04	0.01	0.01	0.01	0.01
Philippines	0.04	0.04	.	.	0.01	0.01
Japan	-0.01	-0.01	.	.		
	Sfwd Plywood		Sfwd Sawnwood		Sfwd Log	
	K	r	K	r	K	r
U.S.A.						
Canada						
Japan	-0.01	-0.01	.	.	-0.03	-0.03

A "." represents nil magnitude in this table and in all other tables.

Table 5.3. Effect on Profitability of Forest Products of a 1% Decrease in Ad Valorem Import Tariff on Processed Forest Products by Japan (% Change)

	Forest Product		
Country	Hdwd Plywood	Hdwd Sawnwood	Hdwd Log
Indonesia	0.0036	0.0001	
Malaysia	0.0016	0.0001	0.0001
Philippines	0.0016	.	0.0001
Japan	-0.0001		
	Sfwd Plywood	Sfwd Sawnwood	Sfwd Log
U.S.A.			
Canada			
Japan	-0.0001	.	-0.0001

of forest products in Japan after decreasing by 1 percent the ad valorem import tariff on processed forest products. The trade flow of processed products from all exporting countries increases. This is attributable to the decrease in the import price of these processed forest products by Japan which has caused demand to increase. This increase in Japanese demand also increases the supply price of processed forest products. There is substitution in favor of imported processed forest products which have become relatively cheaper in the Japanese market. Demand for domestic forest products decreases and consequently, supply prices of domestic forest products also decrease. In addition, this substitution in favor of imported processed forest products, decreases import prices of hardwood logs which cause demand and supply prices for hardwood logs to increase. On the other hand, softwood log trade flow and supply price decrease because of the decrease in the demand for domestic softwood processed products.

The results for employment are presented in Table 5.2. Capital employment and returns to capital in all forest products rise in the exporting countries. This is attributable to the increase in the demand for these forest products in the Japanese market. On the other hand, capital employment and returns to capital in forest products fall in Japan as a result of the decline in the demand for Japanese domestic forest products.

Changes in producer welfare as expressed in terms of the changes in profitability are shown in Table 5.3. Because of the increases in capital employment and in returns to capital in forest products

in the exporting countries, profitability in forest products increases in all exporting countries. In contrast, profitability in forest products in Japan declines because of the decline in capital employment and returns to capital in forest products in Japan.

B. Scenario 2

The effects of increasing by 1 percent the ad valorem export tax on hardwood logs by both Malaysia and the Philippines are shown in Tables 5.4 - 5.6. Table 5.4 shows that for the trade restricting countries, Malaysia and the Philippines, trade flows of hardwood logs decrease. The increase in the export tax increases the import price of hardwood logs by Japan causing Japanese demand for hardwood logs to decrease. With the decrease in the Japanese demand for hardwood logs, hardwood log supply prices decrease. Also, the increase in import price of hardwood logs by Japan causes hardwood processed products production in Japan to decrease. Japanese domestic hardwood processed forest products have become more costly as import prices of hardwood logs increase. As a result, Japan imports more of processed forest products from Malaysia and the Philippines whose supply prices of processed forest products decrease as a consequence of the decrease in the supply price of hardwood logs - the raw material base. The decrease in domestic production, particularly of hardwood sawnwood, increases demand and supply prices of softwood sawnwood and consequently of softwood logs, again because of the

Table 5.4. Effect on Trade Flow (TF) and Supply Price (SP) of Forest Products in Japan of a 1% Increase in Ad Valorem Export Tax on Hardwood Logs by Malaysia and the Philippines (% Change)

	Forest Product					
	Hdwd Plywood		Hdwd Sawnwood		Hdwd Log	
Country	TF	SP	TF	SP	TF	SP
Indonesia	0.05	0.02	0.04	.		
Malaysia	0.10	-0.01	0.05	-0.03	-0.29	-0.27
Philippines	0.10	-0.01	0.05	-0.03	-0.29	-0.27
Japan	-0.10	0.01	-0.07	0.02		
	Sfwd Plywood		Sfwd Sawnwood		Sfwd Log	
	TF	SP	TF	SP	TF	SP
U.S.A.	.	.	0.01	0.01	0.01	0.01
Canada	.	.	0.01	0.04	0.01	0.02
Japan	.	.	0.01	.	0.01	.

Table 5.5. Effect on Capital Employment (K) and Returns to Capital (r) in Forest Products of a 1% Increase in Ad Valorem Export Tax on Hardwood Logs by Malaysia and the Philippines (% Change)

	Forest Product					
	Hdwd Plywood		Hdwd Sawnwood		Hdwd Log	
Country	K	r	K	r	K	r
Indonesia	.	.	.	.		
Malaysia	0.01	0.06	.	.	-0.05	-0.46
Philippines	0.01	0.06	.	.	-0.04	-0.45
Japan	-0.01	-0.06	.	-0.02		
	Sfwd Plywood		Sfwd Sawnwood		Sfwd Log	
	K	r	K	r	K	r
U.S.A.						
Canada						
Japan	.	.	.	0.01	.	0.01

Table 5.6. Effect on Profitability of Forest Products of a 1% Increase in Ad Valorem Export Tax on Hardwood Logs by Malaysia and the Philippines (% Change)

	Forest Product		
Country	Hdwd Plywood	Hdwd Sawnwood	Hdwd Log
Indonesia	.	.	
Malaysia	0.0006	.	-0.023
Philippines	0.0006	.	-0.018
Japan	-0.0006	.	
	Sfwd Plywood	Sfwd Sawnwood	Sfwd Log
U.S.A.			
Canada			
Japan	.	.	.

substitution between hardwood and softwood products.

As a result of the increase in trade flow of processed forest products from Malaysia and the Philippines, capital employment and returns to capital increase in hardwood processed products in these countries (Table 5.5). In contrast, capital employment and returns to capital in hardwood logs in the same countries decrease because of the decrease in the trade flow of hardwood logs to the Japanese market. In Japan, capital employment and returns to capital in hardwood processed forest products in Japan decrease because of the decrease in hardwood processed forest products output. On the other hand, returns to capital in softwood forest products, particularly softwood sawnwood and softwood log, increase. This is because of the increase in softwood processed forest products output.

Economic welfare of the export tax imposing countries, Malaysia and the Philippines, decrease. Table 5.6 shows that profitability in hardwood logs in these countries decreases appreciably due to the decrease in capital employment and returns to capital in hardwood log production. However, profitability in hardwood plywood in these countries increases because of the increase in capital employment and returns to capital in hardwood plywood production. In contrast, profitability in softwood plywood production in Japan declines because of the decrease in capital employment and returns to capital in these products. Other forest products have only very negligible changes in these variables.

C. Scenario 3

The effects of increasing by 1 percent the ad valorem export tax on hardwood logs by Malaysia alone are shown in Tables 5.7 - 5.9. Table 5.7 shows that for the export tax imposing country, Malaysia, trade flow of hardwood log decreases. The increase in the export tax of hardwood log by Malaysia raises the import price of hardwood logs in Japan causing Japanese demand for hardwood logs from Malaysia to decrease and consequently for supply prices of hardwood logs from Malaysia to decrease also. The increase in the import price of hardwood logs from Malaysia causes hardwood plywood and sawnwood production to decrease and hardwood plywood and sawnwood supply prices to increase in Japan. This decline in domestic hardwood processed products production in Japan increases imported hardwood processed forest products trade flow, most especially those from Malaysia whose supply prices decrease because of the decrease in the supply price of hardwood logs. Also, the decline in domestic hardwood forest products production in Japan increases trade flow and supply prices of softwood sawnwood because of the substitution between hardwood and softwood products. Consequently, softwood log trade flow and supply price also increase.

Capital employment and returns to capital in hardwood logs in Malaysia (Table 5.8) decrease because of the decrease in trade in hardwood logs. Similarly, capital employment and returns to capital in hardwood plywood and sawnwood decrease in Japan because of the decrease in trade in these products. Other products show

Table 5.7. Effect on Trade Flow (TF) and Supply Price (SP) of Forest Products in Japan of a 1% Increase in Ad Valorem Export Tax on Hardwood Logs by Malaysia (% Change)

	Forest Product					
Country	Hdwd Plywood TF	SP	Hdwd Sawnwood TF	SP	Hdwd Log TF	SP
Indonesia	0.05	0.02	0.04	.		
Malaysia	0.10	-0.01	0.06	-0.03	-0.29	-0.27
Philippines	0.06	0.12	0.04	0.01	.	.
Japan	-0.09	0.01	-0.07	0.03		
	Sfwd Plywood TF	SP	Sfwd Sawnwood TF	SP	Sfwd Log TF	SP
U.S.A.	.	.	0.01	0.02	0.01	0.01
Canada	.	.	0.01	0.04	0.01	0.02
Japan	.	.	0.01	.	0.01	.

Table 5.8. Effect on Capital Employment (K) and Returns to Capital (r) in Forest Products of a 1% Increase in Ad Valorem Export Tax on Hardwood Logs by Malaysia (% Change)

	Forest Product					
	Hdwd Plywood		Hdwd Sawnwood		Hdwd Log	
Country	K	r	K	r	K	r
Indonesia	.	0.05	.	0.03		
Malaysia	0.01	0.06	.	.	-0.05	-0.46
Philippines	0.01	0.05	.	0.02	.	.
Japan	-0.01	-0.05	.	-0.02		
	Sfwd Plywood		Sfwd Sawnwood		Sfwd Log	
	K	r	K	r	K	r
U.S.A.						
Canada						
Japan	.	.	.	0.01	.	0.01

Table 5.9. Effect on Profitability of Forest Products of a 1% Increase in Ad Valorem Export Tax on Hardwood Logs by Malaysia (% Change)

	Forest Product		
Country	Hdwd Plywood	Hdwd Sawnwood	Hdwd Log
Indonesia	.	.	
Malaysia	0.0006	.	-0.023
Philippines	0.0005	.	.
Japan	-0.0005	.	
	Sfwd Plywood	Sfwd Sawnwood	Sfwd Log
U.S.A.			
Canada			
Japan	.	.	.

positive changes in capital employment and returns to capital because of the increase in trade in these products.

Profitability in hardwood logs in Malaysia decrease as shown in Table 5.9 because of the decreases in capital employment and returns to capital in hardwood log in Malaysia. Similarly, profitability in hardwood plywood in Japan decrease because of the decrease in capital employment and returns to capital in this product in Japan.

D. Scenario 4

The effects of increasing by 1 percent the ad valorem export tax on hardwood logs by the Philippines alone are shown in Tables 5.10 - 5.12. Trade flow of hardwood logs from the Philippines decreases because of the increase in the import price of hardwood logs by Japan. Demand for hardwood logs from the Philippines decreases and as a result, supply price of hardwood logs from the Philippines also decreases (Table 5.10). Trade flow of hardwood processed products from the Philippines increases because of the substitution of hardwood logs by hardwood processed products from the Philippines which have become cheaper because of the decline in the supply price of hardwood logs. Other countries show very insignificant changes with respect to the trade flow and supply price of their forest products. This is because of the small share of the Philippine hardwood log in the Japanese market for forest products that the export tax change has very small effect in the Japanese market and its trade participants.

Table 5.10. Effect on Trade Flow (TF) and Supply Price (SP) of Forest Products in Japan of a 1% Increase in Ad Valorem Export Tax on Hardwood Logs by the Philippines (% Change)

	Forest Product					
Country	Hdwd Plywood TF	SP	Hdwd Sawnwood TF	SP	Hdwd Log TF	SP
Indonesia	.	.	.	.		
Malaysia	.	.	.	.	.	.
Philippines	0.04	-0.02	0.01	-0.04	-0.30	-0.27
Japan	.	.	.	.		
	Sfwd Plywood TF	SP	Sfwd Sawnwood TF	SP	Sfwd Log TF	SP
U.S.A.	.	.	.	.	.	.
Canada	.	.	.	.	.	.
Japan	.	.	.	.	.	.

Table 5.11. Effect on Capital Employment (K) and Returns to Capital (r) in Forest Products of a 1% Increase in Ad Valorem Export Tax on Hardwood Logs by the Philippines (% Change)

	Forest Product					
	Hdwd Plywood		Hdwd Sawnwood		Hdwd Log	
Country	K	r	K	r	K	r
Indonesia	.	.	.	.		
Malaysia	.	.	.	.	.	.
Philippines	.	.	.	.	-0.05	-0.45
Japan	.	.	.	.		
	Sfwd Plywood		Sfwd Sawnwood		Sfwd Log	
	K	r	K	r	K	r
U.S.A.						
Canada						
Japan	.	.	.	.	.	.

Table 5.12. Effect on Profitability of Forest Products of 1% Increase in Ad Valorem Export Tax on Hardwood Logs by the Philippines (% Change)

	Forest Product		
Country	Hdwd Plywood	Hdwd Sawnwood	Hdwd Log
Indonesia	.	.	
Malaysia	.	.	.
Philippines	.	.	-0.023
Japan	.	.	
	Sfwd Plywood	Sfwd Sawnwood	Sfwd Log
U.S.A.			
Canada			
Japan	.	.	.

Only capital employment and returns to capital in hardwood logs in the Philippines are significantly affected by the 1 percent increase in export tax on hardwood logs by the Philippines (Table 5.11). Capital employment and returns to capital decrease in hardwood logs in the Philippines because of the decrease in hardwood log output.

Profitability in the Philippines declines in hardwood logs (Table 5.12) because of the decrease in capital employment and returns to capital in hardwood logs in the Philippines.

E. Implications of the Trade Model on Employment and Returns to Land

Table 5.13 presents the effects on land employment and returns to land of the four scenarios in the different log producing countries. Decreasing import tariff on processed forest products by Japan increases land employment and returns to land in log exporting countries while decreasing those in Japan. This is because of the increase in log production in the exporting countries and the decrease in that in Japan. On the other hand, increasing export tax on hardwood logs by hardwood log exporting countries, decreases land employment and returns to land in log export tax imposing countries while increasing those in Japan. This is attributable to the decrease in the output of hardwood logs from log exporting countries and the increase in the softwood log production in Japan.

Table 5.13. Implications of the Trade Model on Land Employment and Returns in Log Products (% Change)

Exogenous change	Effect on land employment		
	Malaysia	Phils	Japan
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	0.01	0.01	-0.03
2. Increase by 1% in ad valorem export tax on hardwood logs by			
Malaysia and Philippines	-0.04	-0.04	.
Malaysia	-0.04	.	.
Philippines		-0.04	.
	Effect on returns to land		
	Malaysia	Phils	Japan
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	0.11	0.01	-0.03
2. Increase of by 1% in ad valorem export tax on hardwood logs by			
Malaysia and Philippines	-0.41	-0.41	0.01
Malaysia	-0.41	.	0.01
Philippines	.	-0.41	.

Table 2.1. Spatial Percentage Distribution of Forest Product Import Values in Japan by Commodity, 1974-86.

	Hardwood Logs			Softwood Logs		
Origin	1974	1986	%change	1974	1986	%change
Indonesia	45.8	0.0	-100.0	1.7	0.0	-100.0
Malaysia	29.9	85.7	186.6	0.0	0.9	-
Phils	16.8	2.4	-85.7	0.1	0.2	100.0
U.S.A.	0.7	1.2	71.4	58.5	61.5	5.1
Canada	0.1	0.0	-100.0	1.2	10.3	758.3
Russia	0.4	0.3	-25.0	31.6	24.3	-23.1
Oceania	2.5	6.1	144.0	4.8	1.3	-72.9

	Hardwood Sawnwood			Softwood Sawnwood			Plywood		
Origin	1974	1986	%change	1974	1986	%change	1974	1986	%change
Indonesia	1.8	29.7	155.0	-	3.4	-	-	92.3	-
Malaysia	32.3	13.6	-57.9	-	0.1	-	0.5	0.6	16.7
Phils	15.1	11.8	-21.9	-	0.5	-	1.1	-	-
U.S.A.	4.8	19.1	297.9	42.9	35.9	-16.3	0.9	2.1	133.0
Canada	2.2	1.9	-13.6	39.0	48.3	23.8	0.3	2.8	833.3
Russia	0.0	0.1	-	2.8	1.7	-39.3	-	-	-
Oceania	0.3	0.1	-66.7	2.8	1.6	-42.9	-	-	-

the share to the total value of imports in Japan for all commodities is observable. For example, Indonesia's share in hardwood logs and softwood logs exhibited a downward trend; in hardwood sawnwood an upward trend; but for all forest products in general, Indonesia's share decreased as was mentioned earlier.

Through the years, there had been shifts with regard to market leadership by an exporting country in some of Japan's import commodities. For example, Japan's hardwood log imports were first dominated by Indonesia in 1974, then finally in 1986 by Malaysian imports. In hardwood sawnwood, imports from Malaysia first dominated the market and then imports from Indonesia took over. The same trend can be said of softwood sawnwood imports from the United States and from Canada. First, imports from the U.S. dominated the market then imports from Canada took over. In the plywood market, imports from Indonesia emerged as the dominant import in 1986. Softwood logs, on the other hand, had been consistently dominated by imports from the U.S.

In addition, Japan showed a small change (an increase by 11 percent) in the value of its forest products imports through the 13 year period.[8] This again corroborates Korani's (1986) very little variation in Japan's inertia multiplier. Corollary, imported timber will continue to dominate the Japanese forest

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[8]Japan's total values of forest products imports in logs, sawnwood and plywood were U. S. $3.7 billion in 1974 and U. S.$4.1 billion in 1986.

products supply.

C. The Export Supply Side

On the export supply side, Table 2.2 shows the percentage share of hardwood and softwood products exports to Japan in the total exports of the products of the supplying countries. On average, hardwood log exports to Japan represented more than 65 percent of the total exports of the product by Malaysia and the Philippines. Hardwood sawnwood and plywood exports to Japan, on the other hand, constituted only a minor share of the total exports of the same products by Indonesia, Malaysia and the Philippines. Similarly, softwood log exports to Japan by the U. S. and Canada averaged more than 65 percent of the total exports of the same products by the said countries, while softwood sawnwood and plywood exports to Japan by the same countries comprised only a minor share of their total exports of the same products.

Because of the relatively major share of the Japanese market in hardwood and softwood logs held by the Southeast Asian and North American countries, it can be said that these regions are large country exporters in the Japanese market, hence the Japanese market fac- - upward sloping supply curve from these exporters. On the other hand, the minor share of the Japanese market in the hardwood and softwood sawnwood and plywood exports of the above regions indicate that these countries are small exporters in the Japanese market and hence Japan faces the perfectly elastic supply curves of these export products.

Table 2.2. Percent of Hardwood and Softwood Products Export Value to Japan in the Total Forest Products Export Value of Exporting Countries, 1974-85.

	Indonesia		Malaysia			Philippines		
	Hardwood		Hardwood			Hardwood		
Year	Sawnwood	Plywood	Log	Sawnwood	Plywood	Log	Sawnwood	Plywood
1974	3.2	-	71.2	7.9	0.5	81.9	26.1	2.8
1975	3.6	-	66.3	21.2	-	73.0	10.6	-
1976	2.3	-	72.2	2.2	-	70.5	7.8	-
1977	4.1	-	72.4	2.7	0.2	76.8	12.9	0.6
1978	4.9	-	79.9	2.3	-	79.7	14.9	1.5
1979	9.1	-	74.4	3.5	1.0	73.9	14.4	-
1980	8.8	5.3	67.3	4.8	2.3	73.7	25.5	-
1981	7.0	1.4	60.0	4.1	0.6	72.2	23.1	-
1982	15.7	2.6	62.9	6.1	0.5	77.8	35.4	0.2
1983	15.9	1.6	63.5	4.3	0.5	65.2	23.3	-
1984	16.1	4.3	64.6	5.6	1.2	73.9	23.8	-
1985	10.5	7.6	61.5	8.6	0.3	77.5	39.8	0.4
Ave	8.4	3.8	68.0	6.1	0.8	74.7	21.5	1.1

	U. S. A			Canada		
		Softwood			Softwood	
Year	Log	Sawnwood	Plywood	Log	Sawnwood	Plywood
1974	89.9	31.7	0.7	59.1	8.8	0.5
1975	92.0	31.7	0.7	77.5	9.4	0.3
1976	90.8	23.3	0.6	73.9	9.0	1.1
1977	90.2	25.5	1.4	65.2	7.7	0.4
1978	88.2	26.6	2.0	72.3	7.3	0.2
1979	91.0	32.6	2.1	67.4	12.2	1.3
1980	88.9	28.6	2.2	70.5	15.3	3.9
1981	82.1	26.9	1.1	71.2	12.6	3.4
1982	70.6	33.8	1.9	54.2	13.5	3.3
1983	64.4	30.4	1.3	61.5	8.5	4.1
1984	58.5	30.6	2.2	64.5	8.2	3.4
1985	57.7	34.6	2.3	67.6	8.6	3.0
Ave	80.4	29.7	1.5	67.1	10.1	2.1

D. Trade Restrictions

The changing structure of Japan's imported timber supply can be attributed to the changing economic and trade policies of the import supplying countries and Japan.

Log Export Restrictions

Until 1960's the amount of domestic processing of Southeast Asian hardwood logs for exports was small due to the lack of capital and skilled manpower for the development of efficient wood based industries and the urgent need for quick and easy foreign exchange earnings coming from log export sales of these developing countries. Thus, Southeast Asian logs historically dominated Japanese imports of hardwood logs and their hardwood processed products comprised only a very minor share in the Japanese imports of hardwood processed products.

With the growth of newly industrializing countries (NIC's) such as Korea, Taiwan and Singapore; Japan began to import most of its processed hardwood (and also softwood) processed products from these NIC's who import their hardwood raw material logs from their neighbors, namely; Malaysia, Indonesia, and the Philippines. Meanwhile, various incentives, both fiscal and non-fiscal have been given in the log supplying countries in order to promote domestic processing primarily for export.

Hand in hand with the policy of promoting wood processing are quantitative controls to restrict log exports. For example, in 1975, the Philippine government started to impose log export

quotas. Indonesia, in 1980, announced a phase in log export ban. Indonesia concentrated on domestic processing and consequently, Japanese imports of hardwood logs from Indonesia decreased while imports of plywood and sawnwood from Indonesia increased.

For softwood logs, particularly North American softwood logs, a long history of log export restriction exists. In British Columbia, log export restriction dates back in 1901 when the Land Act Amendment required that all timber cut from Crown lands must be manufactured in the province. In Alaska, the U.S. Forest Service has limited log exports since 1928 (Klein and Hackett, 1985). To date; Alaska, Washington, Oregon and California of the U. S. have log export restrictions on National Forests and Bureau of Land Management lands. Further, the U.S. Congress is considering two legislative changes affecting softwood log exports. One would drop the ban on exports from federal lands and the other would permit States to embargo exports of logs from State-owned lands (Flora and McGinnis, 1989). British Columbia of Canada has stricter log export policy which applies to almost 95 percent of the land base (Klein and Hackett, 1985).

Table 2.3 summarizes the present log export restrictions that affect Japanese forest products trade. It has been suggested by Klein and Hackett (1985) that trade distortions arising from log export restrictions in Indonesia, the Philippines and North America undoubtedly result in higher hardwood and softwood log prices in Japan and a corresponding reduction in the quantity of logs imported by Japan.

Table 2.3. Log Export Restrictions in Japan's Suppliers

Country/Region	Description of Restriction
Alaska	No export of unprocessed timber from National forest land
Washington	No export of unprocessed timber from National Forests or Bureau of Land Management (BLM) lands
Oregon	No export of unprocessed timber from National Forests or BLM lands. Restricted export of unprocessed timber from state lands
California	No export of unprocessed timber from National Forests or BLM lands No export of unprocessed timber from state lands
British Columbia	Export of unprocessed timber from public lands by permit, based on surplus only. Provincial export tax of 30% of the three month average selling price less average logging cost set by the Ministry of Forests.
The Philippines	Export of logs by permit Government export tariff of 20% FOB price
Indonesia	Log export ban
Malaysia	Banned exports of selected species and imposed restrictions on others.
Sabah	Export quotas introduced. Government export tax of 60% of FOB price
Sarawak	Proportion of annual cut only available for export in log form. Government export tariff of 10-15% FOB price.

Source: Adapted from Klein and Hackett (1985), Table 10, p.27; Kumar (1986), p.131; and Hyman (1983), p.516.

There has been a proposal to internationally cartelize tropical timber in order to revalue tropical rain forests (Guppy, 1983). The feasibility of such cooperation has been shown regionally in the ASEAN (Association of Southeast Asian Nations) in timber marketing and pricing among its members.[9] However, such cartel oriented international cooperation has received adverse criticisms and is still far from being organized (Guppy, 1983).

Import Restrictions

On the import side, the tariff structure in Japan gives preferential rates to developing and newly industrializing countries in Asia. Thus hardwood logs from Indonesia, Malaysia and the Philippines are free of tariff and processed wood products from Taiwan, Korea, Hongkong and Singapore face lower tariff rates (Table 2.4).

Also from Table 2.4, it can be seen that the average tariff rates rise from sawlog to lumber, from veneer log to veneer sheet to plywood. This tariff escalation is used to protect the domestic

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[9]The ASEAN countries of Indonesia, Malaysia, Philippines and Papua New Guinea founded SEALPA (Southeast Asia Lumber Producers Association) in 1974 in order to regulate production and bargain for better prices from importers. However, owing to the revenue needs of Indonesia and the Philippines, SEALPA has not had a major impact on price by manipulating supply (Kumar, 1982).

Table 2.4. Tariff Rates of Selected Forest Product Imports of Japan Post Tokyo Round (1985).[10]

Description	Tariff Rate	
	GATT	Preferential
Logs*	Free	Free
Lumber except species below:		
Pine, fir, spruce,	8%	Free
Lauan, keruing and other Dipterocarpacea	10%	5% or Free**
Veneers	15%	7.5% or Free
Plywood, varnished, tongue and grooved, etc.	17.5%	
Plywood with both faces softwood	15%	

*Except Kiri logs which are Basic-5%, Preferential-Free.
**Appropriate tariff dependent on degree of economic advancement of country.
Source: Adapted from Klein and Hackett (1985), Table 9, p.17.

[10]The recent GATT negotiations in the Uruguay Round has proposed for the elimination of tariffs, among others, but final negotiations are still underway. See "GATT talks stall on disputed world," 1988.

industry.[11] However, for the exporters, tariff escalation is claimed to adversely affect exports of processed products which are particularly important to developing countries and their industrialization strategies (Olechowski, 1987).

A study claimed that developing countries would experience important increases in exports of mostly processed products to their largest markets, Japan among them, if tariff restrictions are removed.[12] On the other hand, another study claimed that Japan's tariff restrictions on forest products have little effect (0.6 percent) on quantities imported and that nontariff barriers, particularly discriminatory business purchasing appear to be relatively more important (Klein and Hackett, 1985).

A look at the nontariff barriers existing in Japan reveals that the regrading of foreign lumber and plywood, the existence of legislation which facilitates import cartels, and discriminatory business purchasing are among the important barriers in Japanese forest products trade (Klein and Hackett, 1985). A quantitative investigation of the effects of nontariff barriers on

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[11]It was cited that Japan's "tariff structure for timber and timber products discriminated against processed goods in favor of raw logs and against [processed] tropical hardwoods in favor of softwoods, on the ground that the country's domestic sawmills and plywood manufacturers have worked with hardwoods". C. Smith, "Japan faces an army of invisible monsters ... but in Asia Tokyo itself is seen as an ogre," *Far Eastern Economic Review,* October 24, 1984, pp.81-84, quoted in Klein and Hackett (1985).

[12]The estimated trade effects on imports from developing countries of the removal of the post-Tokyo Round tariffs on wood and wood products in Japan is 2.7 percent of the actual imports of Japan. See Olechowski (1987), Table 15.2, p.377.

international trade in wood and wood products for selected developed market economies, Japan including, reported that nontariff barriers as applied to imports of wood and wood products in 1983 accounted for 18.9 percent of the 1981 import value. Further, nontariff barriers are concentrated in primary wood products. Wood in the rough is free of any nontariff controls and secondary wood products face only a few barriers (Olechowski, 1987).

III. ALTERNATIVE TRADE MODELS

This chapter reviews the major approaches available for modeling interregional trade and previous studies applying each approach to the forest products sector. Their advantages and limitations are evaluated with the view of constructing a model that interrelates the variables and conditions identified in the previous chapter as well as adopting a technique that will be useful in implementing the model. At the end, the identification of the appropriate structural characteristics of the model is presented.

A. Non-spatial Model

A highly aggregate model form involves the division of market area into two geographical units: the target country or region of interest and the rest of the world (ROW). In this model type, it is assumed that the geographic boundaries of supply and demand are identical.

Klein and Hackett (1985) quantified the impacts of Japanese removing the Post Tokyo Round Japanese tariffs on selected forest products based on the assumption of a perfectly elastic supply function, imperfect substitutability among different forest products and all country demand changes. They used weighted aggregate elasticity estimates and they concluded that Japan's import restrictions reduce the competitiveness of exporters. The details of this effect with respect to each exporter, however, was

not quantified.

Wiseman and Sedjo (1981) studied the effects of a hypothetical softwood log embargo from the Pacific Coast Region (PCR) of the United States to the PCR and ROW market participants using judgmental estimates of demand and supply elasticities coupled with an explicit treatment of the vertical linkage of log and lumber markets.

The major drawback of this kind of study is the high level of aggregation specifically in the ROW component, which precludes bilateral flows. Consequently, the effects of tariffs and other trade barriers can only be approximated. Furthermore, it may be difficult to give any meaningful interpretation to the ROW component if the countries in the ROW category are numerous or highly diverse (Adams and Haynes, 1987).

In multiregion price equilibrium models, demand and supply from all trading countries interact to determine a world price equilibrium. Prices in all countries are adjusted to the currency and location of a reference country by exchange rates and transportation costs between each country and the reference country.

An example of the above method was employed by Flora (1986) in an equilibrium model of Pacific Rim trade in small softwood logs. Individual export supply and import demand functions were summed to aggregate market supply and demand, with reference to free alongside ship prices along the western shores of North and South

America, and then solved for equilibrium.

Since this model form does not employ the highly aggregated rest of the world region, the problem of excluding both supply and demand side forces in all the supplying countries as variables in the demand function of the region of interest (specification error) is avoided. However, bilateral flows cannot be identified nor can specific bilateral trade restrictions be represented (Adams and Haynes, 1987). Another important limitation of this kind of model is the plausibility of the homogeneity of product assumed from a single equilibrium market price.

B. Spatial Equilibrium Models

Spatial equilibrium models have improved over the earlier generation by incorporating trade flows explicitly. The basic approach here is to estimate separate supply and demand equations for each participating region or country[13] and transport cost equations for each region's geographical centers of production and consumption and to solve for an equilibrium set of prices, quantities and trade flows that minimizes the cost of transporting goods.

Adams and Haynes (1980) built a spatial model of North American softwood lumber, plywood and stumpage market in order to

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[13]Examples of econometric studies which have been conducted in this direction are McKillop (1973), Nomura and Yukutake (1982) and Eleazar (1986).

provide long range projections of price, consumption and production trends. Six geographical demand regions and nine supply regions were represented in the model. Policy simulations of increasing management intensity, elimination of log export, tariffs on Canadian lumber and increases in lumber production costs were also presented.

Adams (1985) developed a spatial equilibrium model of the African-European trade in tropical logs and sawnwood which simulates sawnwood consumption and production, log production, prices and trade flows resulting from market exchanges. A log export tariff in West Africa was simulated.

Conceptually similar to the above model but different in its policy focus is the study of Boyd and Krutilla (1987) on the welfare impacts of U. S. trade restrictions against the Canadian softwood lumber industry.

Vincent's (1987) work on Southeast Asian trade for forest products, on the other hand, quantified the welfare gains for each trade participating region and the optimum tariffs on logs and processed products that are necessary to achieve them.

One of the criticisms directed at the studies mentioned above and to spatial models in general is that the optimal trade flows generated by the model are different from the actual trade flows. This problem stems from the assumption that the goods from different countries are homogeneous or perfect substitutes such that interregional price differences for the good result only from

transport cost and trade barriers. Thus, a small change in transport cost or tariff may immediately reduce a country's export to a particular market from a large volume to zero. If, however, goods are imperfect substitutes, then fewer and different trades occurring than would actually occur would be predicted from the model (Greenes, et al.; 1987). Also, they assume perfect certainty and hence abstract from the policies of importers diversifying sources so as to limit the impacts of trade disruption (Adams and Haynes, 1987).

Modifications employed to remedy the above problems include imposing quantitative restrictions that force trade flows in certain directions and quantities and forbid other flows or appending inertia of trade adjustments.[14]

Given the shortcomings mentioned above and the objectives of this study, it was felt that a model that directly incorporates product heterogeneity is a more suitable analytical tool.

C. Market Share Models

This category of models tackles the problem of product heterogeneity by allowing differences in import demand characteristics depending on the country of origin or destination of the product. They assume that imports from a given country are close, but not perfect substitutes for imports from other

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[14]For examples, see D. P. Dykstra (1983) and Boungiorno and Gilles (1981).

countries or those produced domestically. This effect has been called in the literature, the Armington effect (Armington, 1969).

The reasons advanced for this product heterogeneity assumption are:

1. Goods are intrinsically heterogeneous;
2. Even if a good is intrinsically homogeneous, products may be viewed differently by suppliers because of national factors;
3. Goods are purchased from different suppliers for security reasons;
4. Goods are cross-hauled; and
5. Suppliers' share of the market for the good varies such that individual suppliers face different demand curves.[15]

For interregional trade modeling, the problem posed by adopting these assumptions is that the number of parameters to be estimated becomes unmanageable when trade involves more than a few countries or commodities. To simplify, the Armington models explicitly place some restrictions on the form of the demand equations by assuming:

1. Seperability, i.e., marginal rates of substitution between two products of one kind are independent of products of another kind;
2. The elasticity of substitution between products of a kind competing in a market is constant; and

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[15]This is consistent with an imperfect competition model for tradeable goods. See W. H. Branson (1972) and Greenes, et al.;(1978).

3. The elasticities of substitution between any two products of a kind competing in a market equal the elasticity of substitution between any other two products of that kind competing in that market.

The Armington model has drawn conceptual criticisms because of these constraints. However, Richardson (1973) has put these criticisms to an empirical test by using a body of data which allows the constraints to be loosened, then confirmed or rejected. The results obtained favored the continued use of this model.

Different variants of the model especially in the non forest sector come to exist. Branson (1972) adopted the Armington model and utilized it to examine the trade effects of the 1971 currency realignments on the trade balances of major countries. Truman and Resnick (1973) investigated the effects of alternative tariff structures on West European trade flows using a two stage procedure. In the first stage, imports and home production were differentiated to determine the total imports into a country. In the second stage, imports from various sources were differentiated, and imports allocated on the basis of relative prices among alternative suppliers. A world trade model (Sarris, 1983) using an extension of the Armington model in fruits and vegetables was estimated and used to project the impact on export prices and trade patterns of the European Economic Community trade enlargement. In several studies on world wheat trade (Greenes, et al., 1977; Greenes, et al., 1978; and Johnson, et al., 1979), the

Armington type model has also been used to predict multilateral trade flows and prices of grains. While this type of model generally has been thought to be inappropriate for the grain commodity classification, it was claimed that the model was both theoretically plausible and consistent with the observed data.

In forest products, Chou and Buongiorno (1983) drew upon the Armington model and the work of Hickman and Lau (1973) to estimate empirical models of U. S. demand for hardwood plywood imports by country of origin.

Percy (1986) in his general equilibrium model of forest industry and the British Columbia economy also utilized the Armington effect in formulating intermediate and final demands of manufactured goods.

Another application of the market share model is the work of Castillo and Laarman (1984) which studied price competitiveness of softwood lumber exports to the Carribean markets.

More recently, Constantino (1988) also used the Armington effect in a trade model of Indonesian wood products. Substitution between temperate and tropical wood products is considered in demand for wood products from U.S.A., Japan, Europe, Indonesia, Other Asia, and Rest of the World.

D. Equilibrium Process Models

Rather than explicitly estimating excess demand and excess supply in each region, as in the case of some of the above models,

equilibrium process models focus only on the bilateral trade of two regions but considerably details domestic production and total demand for each region.

Gallagher (1983) provides an extensive theoretical examination of this general approach in the context of a regional model of North American trade in forest products. Essentially, process models consist of final product demand, product price, product equilibrium, production process and factor demand and supply equations.

As cited in Adams (1987), Adams's analysis of the Lake State's pulpwood trade; Gallagher's model of U.S.-Japan log and lumber trade; Adams, et al's model of U.S.-Canadian lumber trade and Merz's analysis of pulpwood markets in Michigan are examples of studies which have employed the above approach in forest products.

E. Conclusion

Based on the scope and objectives of this study, the review of the Japanese forest products trade and the foregoing review of previous studies, the model for this study should incorporate three characteristics. First, it should be interregional. A set of economically important countries is essential in studying the Japanese trade because of their dominance of the particular forest product market and their close trading relationship or interdependence. Second, demand functions should include

substitution measures for each heterogeneous product identified. Third, vertical market relationship which influence the composition of raw materials and processed products trade should be considered because of the important interrelationships between logs and lumber and plywood products. Thus Armington type final product demands for each region, factor supply and processing cost and factor return equations are the basic elements of the model to be constructed.

The model, when solved, will yield interregional trade quantities and prices at multiple market levels and regional factor employment levels and rates. Price endogeneity will be achieved by imposing market clearing conditions in both the product and factor markets so that all prices adjust until decisions made in the productive sectors are consistent with the final demand decisions made in the demand sector and by other independent decison makers.[16]

This model structure is similar to the wood products trade model for Indonesia developed by Constantino (1988). However, it differs in its focus on the Japanese market, regional disaggregation of the Asian countries into Indonesia, Malaysia and

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[16]This does not mean that the model cannot accommodate the imperfect competitive behavior observed in the market. Monopoly power will be incorporated in the model by using the relevant perceived demand elasticities in the product demand equations. Also, import price equations include price mark-ups in the form of import tariffs and export taxes levied by governments. These model extensions do not alter the basic market clearing nature of the model solution (Dervis, 1982).

the Philippines, inclusion of Canada and exclusion of the European and the Rest of the World countries. Also, its policy scenarios are different.

IV. THE MODEL

This chapter discusses the theoretical aspects of the model and its implementation. The model is described in terms of its assumptions and equations and its application to the Japanese [illegible] is detailed in terms of structure, data and parameters and solution procedure. A description of the scenarios examined in the model ends the chapter.

A. Theoretical Description of the Model

Overview of the Model

The model used in the study incorporates interregional linkages, vertical product relationships and the Armington effect. In particular, this study differs from the previous studies in assuming:

1. Imperfect substitutability between similar products produced from different countries and between softwood and hardwood products;
2. Interaction among the different products, specifically that of logs and products derived from it; and
3. Interaction among trade participating countries.

The model ignores intersectoral linkages, except in the logging and wood products industries which produce sawnwood and plywood, intertemporal linkages and general equilibrium

interactions. Thus a maintained hypothesis of this analysis is that in the countries considered, the forest products sector is just a small fraction of their respective general economies, and for a particular country, repercussions of shocks in the forest sector on the general economy can be ignored. The model's supply and demand equations are derived from cost minimization and utility maximization behavior of producers and consumers in perfectly competitive markets.

To simplify the solution, the equations of the model are first converted to relationships specified in terms of proportional change and the resulting linear system is solved computationally. One advantage of this method is its few data requirements which is particularly important when dealing with developing countries where the lack of data has often posed a problem. Another advantage is the ease with which the results can be interpreted. They are in elasticity form and represent a multiplier, that is, the proportional change in an endogenous variable for a given proportional change in an exogenous variable. Since the model is linear in variables, the solution can be obtained by matrix inversion. Greater computational detail can be obtained, permitting the inclusion of a greater variety of policy parameters. It is important to note, however, that since the model is linearized in the neighborhood of an initial equilibrium, the model yields only an approximation to comparative static changes in the neighborhood of an initial equilibrium rather than old and new equilibrium. Thus results are only approximations and their

accuracy depends on whether the changes considered are relatively small. The emphasis in this study is in developing the model as a practical tool of analysis for trade policy.

Equations of the Model

The complete model is presented below. All functional forms in the rate of change format appear in Appendix A.

The model includes r countries, j=1,...,r, exporting n goods, i=1,...,n. A distinguishing characteristic of the model is that both producers and consumers distinguish between home goods which are produced and used domestically and those that are either exported or imported.

Trade Flows

The model draws heavily on the theoretical model developed by Armington (1969). The following assumptions are made:

1. The marginal rates of substitution between any two products of the same kind must be independent of the quantities of the products of all other kinds; and
2. The market shares must depend only on relative prices of the products in the market.

Two stage optimization thus leads to the resulting demand functions:

$$(1) \qquad x_i = x_i(Y_i, p_1, p_2, \ldots, p_n)$$

$$(2) \qquad x_{ij} = x_{ij}\left(x_i, \frac{p_{ij}}{p_{i1}}, \frac{p_{ij}}{p_{i2}}, \cdots, \frac{p_{ij}}{p_{in}}\right)$$

i = product index, $1,\ldots,n$

j = supplying country index, $1,\ldots,r + 1$

where:

x_i = demand for any good i

x_{ij} = demand for any product i from supplying country j

p_i = price of good i

p_{ij} = price of product i from supplying country j

$Y_i = \Sigma p_i x_i$.

Equations (1) and (2) state that the demand for any particular product x_{ij} can be written as a function of x_i and the relative product prices in the i^{th} market and that the demand for x_i can in turn be related to the appropriate price and income variables.

Equivalently, the demand for any product depends on the product's share in the market and the market in which it competes. Its product's share in the market depends in a specific way on the product's price relative to the prices of products in the market. The market effect depends mainly on the income and the income elasticity of demand and the price and price elasticity of demand for the respective good, i.e., the class of products of which the product is a member.

If many countries are identified in the model, equation (2), in the above form, will probably be too complicated to be of practical use. To simplify them, the following assumptions are introduced:

1. Elasticities of substitution in each market are constant; and
2. The elasticity of substitution between any two products

competing in the same market is the same as that between any other pair of products competing in the same market.

Given these assumptions, it can be shown that equations (2) have the form:

$$(3) \qquad x_{ij} = b_{ij}^{\sigma_i} \, x_i \left(\frac{p_{ij}}{p_i} \right)^{-\sigma_i}$$

where:

σ_i = elasticity of substitution in the i^{th} market

b_{ij} = constant.

Trade Prices

The price of goods p_i is a function of the prices of products in the i^{th} market:

$$(4) \qquad p_i = p_i \, (p_{i1}, p_{i2}, \ldots, p_{ir})$$

such that the demand for the i^{th} good, which it explains is consistent with the optimum selection of the products in the i^{th} market.

The price of the product i from country j in the importing country, p_{ij} , is:

$$(5a) \qquad p_{ij} = (1 + t_i^m) \, p_{ij}^e \text{ or}$$

$$(5b) \qquad (1 - t_{ij}^x) \, p_{ij} = p_{ij}^e$$

where:

p_{ij}^e = internal supply price of product i in the exporting country j

t_i^m = ad valorem tariff on imports of product i into the

importing country

t^{x}_{ij} = ad valorem export tax on exports of product i from country j into the importing country.

Market Clearing Conditions

Production in each of the forest products industries in each country is characterized by the following production relationship:

(6) $x_{ij} = x_{ij}(n^{j}, k^{ij}, l^{ij}, x_{ji})$

where:

x_{ij} = output of production i in the supplying country j

n^{j} = labour input in country j

k^{ij} = capital input for product i in country j

l^{ij} = land input for product i in country j

x_{ji} = intermediate input.

For plywood and sawnwood products, the primary factors considered are labour and capital and the intermediate input considered is logs. For log products, land is another primary factor input included.

Assuming perfect competition and constant returns to scale, there corresponds to the above production function a unit cost function which equates producer prices to average costs:

(7) $C^{ij}(w^{j}, r^{ij}, v^{ij}, p^{ji}) = p^{e}_{ij}$

where:

C^{ij} = cost function of product i in country j

w^{j} = wage rate of labour in country j

r^{ij} = rental charge of capital in product i in country j

F. Scenario Implication to the Softwood Products from North America

Table 5.14 summarizes the effects of the above scenarios on the trade flow and supply prices of softwood products from the United States and Canada. With respect to decreasing the import tariff on processed forest products by Japan, the effects on softwood products from North America are significant. Trade flow and supply prices of plywood and sawnwood increase while trade flow and supply price of softwood logs decrease. The decline in the softwood log trade and supply prices is due to the decline in the domestic production of softwood processed products in Japan.

Increasing the export tax on hardwood logs by Malaysia and the Phili pines or by Malaysia alone increases trade flow and supply price of sawnwood and logs from the United States and Canada. Again, this is because of the decrease in domestic hardwood sawnwood production and the substitution of softwood products for hardwood products in the Japanese market.

Increasing the export tax on hardwood logs by the Philippines alone has very negligible effects on softwood products from North American because of the smallness of the forest product imports from the Philippines in the Japanese forest products market.

G. Scenario Implications to the Japanese Domestic Market

Table 5.15 shows the implications of the trade model on Japanese domestic forest products trade and supply prices. Decreasing the ad valorem import tariff on processed forest

Table 5.14. Implications of the Trade Model on Softwood Products from North America (% Change)

Exogenous change	Effect on the trade flow		
	Plywood	U.S.A. Sawnwood	Logs
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	0.20	0.01	-0.41
2. Increase by 1% in ad valorem export tax on hardwood logs by			
Malaysia and Philippines	.	0.01	0.01
Malaysia	.	0.01	0.01
Philippines	.	.	.
	Plywood	Canada Sawnwood	Logs
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	0.20	0.01	-0.41
2. Increase by 1% in ad valorem export tax on hardwood logs by			
Malaysia and Philippines	.	0.01	0.01
Malaysia	.	0.01	0.01
Philippines	.	.	.

Table 5.14 (Continued)

Exogenous change	Effect on supply price		
	Plywood	U.S.A. Sawnwood	Logs
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	0.25	0.02	-0.41
2. Increase by 1% in ad valorem export tax on hardwood logs by			
Malaysia and Philippines	.	0.01	0.01
Malaysia	.	0.02	0.01
Philippines	.	.	.
	Plywood	Canada Sawnwood	Logs
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	0.25	0.04	-0.71
2. Increase by 1% in ad valorem export tax on hardwood logs by			
Malaysia and Philippines	.	0.04	0.02
Malaysia	.	0.04	0.02
Philippines	.	.	.

Table 5.15. Implications of the Trade Model on Japanese Domestic Forest Products (% Change)

Exogenous change	Effect on the trade flow		
	Hdwd Ply	Hdwd Sawn	
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	-0.02	0.07	
2. Increase by 1% in ad valorem export tax on hardwood logs by			
Malaysia and Philippines	-0.10	-0.07	
Malaysia	-0.09	-0.07	
Philippines	.	.	
	Sfwd Ply	Sfwd Sawn	Sfwd Log
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	-0.15	-0.06	-0.34
2. Increase by 1% in ad valorem export tax on hardwood logs by			
Malaysia and Philippines	.	0.01	0.01
Malaysia	.	0.01	0.01
Philippines	.	.	.

Table 5.15 (Continued)

Exogenous change	Effect on supply price		
	Hdwd Ply	Hdwd Sawn	
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	-0.11	-0.09	
2. Increase by 1% in ad valorem export tax on hardwood logs by			
Malaysia and Philippines	0.01	0.03	
Malaysia	0.01	0.03	
Philippines	.	.	
	Sfwd Ply	Sfwd Sawn	Sfwd Log
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	-0.07	-0.02	-0.15
2. Increase by 1% in ad valorem export tax on hardwood logs by			
Malaysia and Philippines	.	.	.
Malaysia	.	.	.
Philippines	.	.	.

products by Japan, in general, decreases trade quantities and supply prices of Japanese forest products. This is brought about by the increase in the trade flow of cheaper imported forest products.

Increasing the ad valorem export tax on hardwood logs by both Malaysia and the Philippines and by Malaysia alone decreases trade quantities of Japanese hardwood domestic forest products because of the decrease in the trade flow of imported hardwood logs - the raw material base. But because of this decrease in imported hardwood logs, trade quantities of domestic softwood products increase. Also, supply prices of Japanese hardwood processed products increase because of the increase in hardwood log import price. For softwood domestic products, no significant changes in supply prices occur.

Increasing the ad valorem export tax on hardwood logs by the Philippines alone has very negligible effect on domestic forest products trade quantities and supply prices. Again, this is because of the smallness of the Philippine imports in the Japanese forest products market.

H. Scenario Implications to National Income of Countries

Table 5.16 presents the change in national income of countries under different scenarios. Under Scenario 1, all of Indonesia, Malaysia and the Philippines experience increases in national income. This is because of the positive effects of the decrease in import tariffs on processed forest products by Japan on the

Table 5.16. Contribution of Forest Products Sector to National Income under Different Scenarios (% Change)

Country/ Scenario	Net Change N. Income	Forest Products Sector		
		Hdwd Ply	Hdwd Sawn	Hdwd Log
Indonesia		(0.52)	(0.56)	
Scenario 1	0.0111	0.0103	0.0008	.
Scenario 2	.	.	.	
Scenario 3	0.0110	0.0086	0.0024	
Scenario 4	.	.	.	
Malaysia		(0.13)	(0.83)	(0.78)
Scenario 1	0.0062	0.0013	0.0017	0.0032
Scenario 2	-0.1441	0.0019	.	-0.1460
Scenario 3	-0.1441	0.0019	.	-0.1460
Scenario 4	.	.	.	.
Philippines		(0.67)	(1.53)	(0.78)
Scenario 1	0.0077	0.0013	0.0032	0.0032
Scenario 2	-0.1331	0.0097	.	-0.1428
Scenario 3	0.0145	0.0081	0.0064	.
Scenario 4	-0.1428	.	.	-0.1428
Japan		(0.05)	(0.13)	
Scenario 1	-0.0002	-0.0001	.	
Scenario 2	-0.0007	-0.0007	-0.0004	
Scenario 3	-0.0006	-0.0006	-0.0004	
Scenario 4	.	.	.	

Numbers in parentheses represent the share of the sector in GDP.

Table 5.16 (Continued)

Country/ Scenario	Forest Products Sector		
	Sfwd Ply	Sfwd Sawn	Sfwd Log
Japan	(0.06)	(0.28)	(0.01)
Scenario 1	-0.0001	.	.
Scenario 2	.	0.0004	.
Scenario 3	.	0.0004	.
Scenario 4	.	.	.

returns to factors of production in forest products from these countries. In contrast, Japan experiences a decrease in national income because of the decrease in the returns to its factors of production.

In Scenario 2, Malaysia, Philippines and Japan experience decreases in their national income. In the case of Malaysia and the Philippines, this is attributed to the decline in the returns to factors of production in their hardwood log sector which exceeds the gains made in their hardwood processed products sector. The decrease in Japan is due to the decline in the returns to factors of production in the hardwood processed products sectors whose outputs decline because of the higher cost of imported hardwood logs from Malaysia and the Philippines.

In Scenario 3, Indonesia and the Philippines experience increases in their national incomes. This is because of the increase in their hardwood processed products production as more of these products are substituted in the Japanese market for the more expensive unprocessed hardwood logs from Malaysia. Malaysia's national income falls because of the decline in the returns to factors of production in the hardwood log sector which more than offsets the gains made in the hardwood processed products sector. Japan experiences a decrease in its national income because of the decrease in hardwood processed products production which in turn is attributable to the higher cost of log input.

In Scenario 4, only the Philippines experience a decline in

national income. All other countries are not significantly affected. The national income of the Philippines falls because of the decline in the returns to factors of production in the hardwood log sector.

Considering the net change in national income of all countries, Scenario 1 (with the most positive net income change) is the most beneficial policy. Decreasing the import tariff on all processed forest products by Japan results in increases in national income of exporters which more than offsets the decrease in the national income of Japan. Increasing the export tax on hardwood logs results in a decrease in the national income of the export tax imposing country.

I. Sensitivity of Results to Changes in Parameters

Two separate runs were made to test for the sensitivity of the results to changes in parameters. First, elasticities of substitution among products in Japan were doubled. Then, elasticities of substitution between factors of production were doubled. The results of these runs are too detailed for presentation here, and so only a brief qualitative description is presented here.

Doubling elasticities of substitution among products in Japan has very little effect on the sign and the magnitude of the results obtained (Appendix C). In general, no change in the direction of the endogenous variables is observed for all scenario runs. Also, the difference in magnitude between the base and the

sensitivity analysis results are very small. It can be said that the model is not sensitive to the change in the elasticity of substitution among products parameters.

Further, doubling elasticities of substitution between factors of production does not produce major sign changes and most of the results are very close in magnitude to the base results (Appendix D). Similarly, it can be said that this model is not sensitive to this change in parameters.

VI. SUMMARY AND RECOMMENDATIONS

The principal findings of this study are as follows:

1. Decreasing the import tariff on all processed plywood and sawnwood by Japan increases trade of these processed forest products from Malaysia, Indonesia, Philippines, United States and Canada. Supply prices for these products also increase because of the increase in demand. Demand for Japanese domestic products declines with supply prices also declining. Capital employment, returns to capital and profitability in processed forest products increase in the exporting countries and decrease in the Japanese domestic forest products sector.
2. Increasing the export tax on hardwood logs by both Malaysia and the Philippines decreases the trade flow of hardwood logs and increases the trade flow of hardwood processed forest products. Demand for hardwood logs falls as import price increases. Domestic production of hardwood processed forest products in Japan decreases because of the high cost of hardwood logs. An increase in the trade flow of softwood forest products results as the unsatisfied demand for hardwood logs is absorbed by the softwood products. Consequently, supply prices of softwood forest products rise. Returns to capital and profitability decrease in hardwood log production and capital employment, returns to capital and profitability in hardwood processed forest products increase in the tax imposing

countries.

3. Increasing the export tax on hardwood logs by Malaysia alone decreases trade flow of hardwood logs from Malaysia with a corresponding decrease in the supply price. Trade flows of all other imported forest products increase because of the decrease in the Japanese domestic hardwood products production due to the high import cost of hardwood logs. Capital employment, returns to capital and profitability in hardwood processed forest products in exporting countries increase while those of hardwood logs in Malaysia decrease. In Japan, capital employment, returns to capital and profitability hardwood processed forest products fall.
4. Increasing the export tax on hardwood logs by the Philippines alone increases trade flow of hardwood processed products from the Philippines while decreasing its trade flow of hardwood logs. Capital employment, returns to capital and profitability in hardwood logs in the Philippines decrease. For the other countries no significant change in these variables is observed.
5. With regard to land, decreasing the import tariff on all processed forest products increases land employment and returns to land in hardwood log producing countries while decreasing those in softwood logs in Japan. Increasing the export tax on hardwood logs decreases land employment and returns to land in the log exporting countries.
6. For softwood products from North America, Scenario 1 increases

trade flow and supply price of all processed softwood products while decreasing the trade flow and supply price of softwood logs. Scenarios 2, 3 and 4 all increase trade flow and supply price of all softwood forest products.

7. For the Japanese domestic market, decreasing the import tariff on all processed forest products leads to decreases in the demand and supply prices of Japanese domestic forest products. Increasing the export tax on hardwood logs decreases Japan hardwood processed forest products demand because of the increase in their supply price. On the other hand, demand for domestic softwood sawnwood and log demand increase.
8. Decreasing the import tariff on processed forest products by Japan results in increases in the national income of import import supplying countries which more than compensates for the decrease in the national income of Japan. Increasing the export tax on hardwood logs results in a decrease in the national income of the export tax imposing country.

In general, the findings show that decreasing import tariff in Japan has positive effects on trade flows, supply prices, capital employment and returns to capital for all exporting countries, whereas, the opposite is true for the Japanese domestic producers. Increasing export tax on hardwood logs decreases the trade flow and supply price of hardwood logs and increases trade flow and decreases supply price of hardwood processed forest products from the tax imposing country(ies). Similarly, it also decreases capital

and land employment and returns to capital and land in hardwood logs and increases capital employment and returns to capital in hardwood processed forest products from the tax imposing country(ies). Hardwood processed products from Japan become more costly and consequently their demand decrease while demand and supply price of its softwood products increase together with those of imported softwood products.

If tariff in processed products in Japan were placed so as to protect domestic industry (plywood and sawnwood), the results of this study show that their removal will produce negative effects, i.e., decreases in capital employment, returns to capital and profitability in the processed forest products industry of Japan. Based on national income gains, it can be said that the developing countries of Malaysia, Indonesia and the Philippines should vigorously lobby for forest products trade liberalization in Japan. Alternatively, they (Malaysia and the Philippines) can use export taxes in hardwood logs to benefit their processed forest products industries but at the expense of their hardwood log industries. Malaysia can impose an increase in export tax by itself without any further loss in its national income. For the Philippines, the least cost strategy in imposing an export tax is the one in which it joins Malaysia in imposing the same export tax increase. The Philippines being a fringe supplier loses more if it pursues an export tax increase in hardwood logs by itself. In the case of Indonesia, all policy scenarios give positive

results.

The magnitude of the results show that changes in trade restrictions have more pronounced effects in the hardwood forest products market than in the softwood forest products market. Nevertheless, for the United States and Canada, all policy scenarios yield beneficial results for their softwood forest products, except Scenario 1 where the trade flow and supply price of softwood logs decrease. For Japan, only the restrictions in hardwood logs benefit its forest products sector, particularly, the softwood sector.

The results suggest that reduction in non tariff barriers in Japan may make the benefits from further liberalization of the Japanese market for forest products more substantial.

In this study a computational model of production and trade in the Japanese forest products market has been constructed to analyze the probable effects of changes in tariffs and export taxes in the light of the Armington theory and cartel like export tax solution. The model focuses on microeconomic interactions among industries and countries. It has been difficult to trace the line of cause and effect with respect to analyzing trade policy changes in a particular country as pricing relationships include the effects of development in foreign forest products markets. The model has undergone a series of refinements and while the model discussed here is probably not the best, it is nevertheless

workable. Time and resources permitting, the model can be modified and extended to include non tariff barriers, more exporting countries, a rest of the world component and more forest products. Also, the production functions can be more complex rather than a fixed proportion production function if more products are included.

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APPENDIX A: ANALYSIS OF CHANGE

Total differentiation of the product demand function (3) and the market demand function (1) yields the following:

The percent change in market demand , $\dot{x}_i$, is:

(1') $\dot{x}_i = \eta_i \dot{Y}_i - \varepsilon_i \dot{p}_i$

where:

η_i = expenditure elasticity for product i in the importing country

ε_i = absolute value of price elasticity of aggregate demand for product i in the importing country.

(Except for some, the variables were as defined in Chapter 4 and the dots denote percent changes, e.g., $\dot{x} = dx/x$.)

The percent change in product demand function, $\dot{x}_{ij}$, is:

(3') $\dot{x}_{ij} = \dot{x}_i - \sigma_i(1-s_{ij})\dot{p}_{ij} + \sum_{\substack{i=1 \\ i \neq j}}^{r+1} \sigma_i s_{ij} \dot{p}_{ij}$

where:

s_{ij} = base period value share of the of product i originating from the jth producing country in the importing country

σ_i = absolute value of elasticity of substitution for product i in the importing country

The percent change in price index, p_i, is expressed as

(4') $\dot{p}_i = \sum_{j=1}^{r} s_{ij} \dot{p}_{ij}$

The percent change in the price of product i originating from country j in the importing country m, p_{ij}, is.

(5a') $(1+t_i^m / t_i^m)\, \dot{p}_{ij} = \dot{p}_{ij}^c + \dot{t}_i^m$ or

$$(5b') \quad -\dot{p}_{ij} = (1 - t^{x}_{ij}/t^{x}_{ij})\,\dot{p}^{e}_{ij} + \dot{t}^{x}_{ij}$$

The percent change in internal supply price of product i in country j, $\dot{p}^{e}_{ij}$, is:

$$(7') \quad \dot{p}^{e}_{ij} = s^{ij}_{r}\,\dot{r}^{ij} + s^{j}_{w}\,\dot{w}^{j} + s^{ij}_{v}\,\dot{v}^{ij} + \Sigma\, s^{ij}_{p}\,\dot{p}^{ij}_{ji}$$

where:

s^{ij}_{r} = value share of capital in output i in producing country j

s^{ij}_{w} = value share of labor in output i in producing country j

s^{ij}_{v} = value share of land in output i in producing country j

$s^{ij}_{p_{ji}}$ = value share of intermediate input j in output i in producing country j.

The solutions to the factor market equations are:

The percent change in capital input in product i in country j, $\dot{k}_{ij}$:

$$(8') \quad \dot{k}^{ij} = \dot{x}_{ij} + \sigma^{ij}_{rw}\,s^{ij}_{w}\,\dot{w}^{j} + \sigma^{ij}_{rv}\,s^{ij}_{v}\,\dot{v}^{ij} + \Sigma\,\sigma^{ij}_{rp_{ji}}\,s^{ij}_{p_{ji}}\,\dot{p}^{ij}_{ji} - (\sigma^{ij}_{rw}\,s^{ij}_{w} + \sigma^{ij}_{rv}\,s^{ij}_{v} + \Sigma\,\sigma^{ij}_{rp_{ji}}\,s^{ij}_{p_{ji}})\,\dot{r}^{ij}$$

Also, the percent change in land input in product i in country j, $\dot{l}_{ij}$:

$$(9') \quad \dot{l}^{ij} = \dot{x}_{ij} + \sigma^{ij}_{vw}\,s^{ij}_{w}\,\dot{w}^{j} + \sigma^{ij}_{vr}\,s^{ij}_{r}\,\dot{r}^{ij} + \Sigma\,\sigma^{ij}_{vp_{ji}}\,s^{ij}_{p_{ji}}\,\dot{p}^{ij}_{ji} - (\sigma^{ij}_{vw}\,s^{ij}_{w} + \sigma^{ij}_{vr}\,s^{ij}_{r} + \Sigma\,\sigma^{ij}_{vp_{ji}}\,s^{ij}_{p_{ji}})\,\dot{v}^{ij}$$

It is assumed that elasticity of substitution between any two factors in each product i in the producing country j are similar.

The percent change in the aggregate demand for intermediate input, logs in the importing country is given by:

$$(10') \qquad \dot{x}_{jl} = \sum_{j=1}^{2} r_{l}^{-1} \dot{x}_{lj}$$

The percent changes in factor supplies in the producing countries are expressed as:

The percent change in capital supply in product l in country j, $\dot{k}^{lj}$:

$$(11') \qquad \dot{k}^{lj} = \alpha_{r}^{j} \dot{r}^{lj}$$

and the percent change in supply of land in product l in country j, $\dot{l}^{lj}$:

$$(12') \qquad \dot{l}^{lj} = \alpha_{v}^{j} \dot{v}^{lj}.$$

The percent change in the export supply of softwood product l from exporting country j is:

$$(13) \qquad \dot{x}_{lj} = \gamma_{lj} \dot{p}_{lj}.$$

APPENDIX B: PARAMETER VALUES

The following are the indices used:

i = Product Index

1	hardwood plywood	4	softwood sawnwood
2	softwood plywood	5	hardwood log
3	hardwood sawnwood	6	softwood log

j = Supplying (Producing) Country Index

1	Indonesia	4	United States
2	Malaysia	5	Canada
3	Philippines	6	Japan

Product Value Share, s_{ij}[19]

$s_{11} = .41$	$s_{31} = .24$	$s_{52} = .96$
$s_{12} = .10$	$s_{32} = .13$	$s_{53} = .04$
$s_{13} = .04$	$s_{33} = .14$	
$s_{16} = .45$	$s_{36} = .49$	
$s_{24} = .30$	$s_{44} = .21$	$s_{64} = .45$
$s_{25} = .42$	$s_{45} = .36$	$s_{65} = .08$
$s_{26} = .28$	$s_{46} = .46$	$s_{66} = .47$

[19]Value share was computed as the ratio of the expenditure in Japan for product i from supplying country j to the total expenditure in Japan for product i from all supplying countries. The base period used was 1985 and the data were taken from the UN Commodity Yearbook.

Aggregate Expenditure Share, s_i

$s_1 = .3$ $s_2 = .7$[20]

$s_3 = .69$ $s_4 = .31$[21]

Factor Value Shares, s_r^{ij}, s_w^{ij}, s_v^{ij}, $s_{p_{ji}}^{ij}$

$s_r^{11} = .30$ $s_w^{11} = .25$ $s_{p_{51}}^{11} = .42$[22]

$s_r^{31} = .13$ $s_w^{31} = .12$ $s_{p_{53}}^{31} = .72$[23]

$s_r^{12} = .22$ $s_w^{12} = .66$ $s_{p_{51}}^{12} = .09$[24]

$s_r^{32} = .19$ $s_w^{32} = .66$ $s_{p_{53}}^{32} = .12$[25]

$s_r^{52} = .37$ $s_w^{52} = .35$ $s_v^{52} = .25$[26]

$s_r^{13} = .22$ $s_w^{13} = .66$ $s_{p_{51}}^{13} = .09$[27]

20See L. F. Constantino, Appendix B, p.101.

21Computed as the ratio of the expenditure in aggregate product i to the total expenditure in both softwood and hardwood product i. The base period was 1985 and the data were taken from UN Commodity Yearbook.

22Derived from Table 7 of S. Priasukmana, "The trade and investment opportunities of the forestry sector in East Kalimantan," in G. F. Schreuder (ed.), p.214.

23Derived from S. Priasukmana, Table 9, p.216

24Based on Asia's expenditure share of respective factors inputs in plywood production cost in L. F. Constantino, Appendix B, p.102

25Based on Asia's expenditure share of respective factor inputs in sawnwood production cost in L. F. Constantino, Appendix B, p.102

26Derived from S. Priasukmana, Table 4, p.211

27Based on Asia's expenditure share of respective factor inputs in plywood production cost in L. F. Constantino, Appendix B, p.102

$s_r^{33} = .19$ $s_w^{33} = .66$ $s_{p_{53}}^{33} = .12$[28]

$s_r^{53} = .37$ $s_w^{53} = .35$ $s_v^{53} = .25$[29]

$s_r^{16} = .21$ $s_w^{16} = .49$ $s_{p_{51}}^{16} = .27$[30]

$s_r^{26} = .10$ $s_w^{26} = .12$ $s_{p_{62}}^{26} = .74$[31]

$s_r^{36} = .14$ $s_w^{36} = .54$ $s_{p_{53}}^{36} = .74$[32]

$s_r^{46} = .14$ $s_w^{46} = .54$ $s_{p_{64}}^{46} = .74$[33]

$s_r^{66} = .14$ $s_w^{66} = .54$ $s_v^{66} = .74$[34]

Recovery Rate, r_j^{-1}[35]

$r_1^{-1} = 1.67$ $r_2^{-1} = 1.67$ $r_3^{-1} = 1.67$

$r_4^{-1} = 1.67$

Expenditure Elasticity, η_i[36]

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[28]Based on Asia's expenditure share of respective factor inputs in sawnwood production cost in L. F. Constantino, Appendix B, p.102.

[29]Derived from S. Priasukmana, Table 4, p.211.

[30]Based on Japan's expenditure share in respective factor inputs in plywood production cost in L. F. Constantino, Appendix B, p.101.

[31]Derived from Figure 13 of D. D. Baskerville, "Meeting Japanese product requirements observations from a management perspective," in G. F. Schreuder (ed.), p. 96.

[32]Based on Japan's expenditure share in respective factor inputs in sawnwood production cost in L. F. Constantino, Appendix B, p.101.

[33]Based on Japan's expenditure share in respective factor inputs in sawnwood production cost in L. F. Constantino, Appendix B, p.101.

[34]Based on Japan's expenditure share in respective factor inputs in sawnwood production cost in L. F. Constantino, Appendix B, p.101.

[35]See G. F. Schreuder and R. P. Vlosky, Table 8, p.174.

[36]Refers to the aggregate of both softwood and hardwood products. See Inomura, Table 3, p.62.

$\eta_{1\&2} = .81$ $\eta_{3\&4} = .26$

Elasticity of Aggregate Demand, ε_i[37]

$\varepsilon_{1\&2} = 1.14$ $\varepsilon_{3\&4} = .47$

Elasticity of Substitution, σ_i

$\sigma_{1\&2} = 1.23$ $\sigma_{3\&4} = 2.11$[38]

$\sigma_1 = 12.30$ $\sigma_2 = 12.30$ $\sigma_3 = 4.39$[39]

$\sigma_4 = 1.52$ $\sigma_5 = 3.22$ $\sigma_6 = .44$[40]

Primary Factors Elasticity of Substitution, σ^{ij}_{rw} ($= \sigma^{ij}_{rp_{ji}} = \sigma^{ij}_{vw} = \sigma^{ij}_{vr} = \sigma^{ij}_{vp_{ji}}$)

$\sigma^{11}_{rw} = 1.29$ $\sigma^{31}_{rw} = 1.67$[41]

$\sigma^{12}_{rw} = 1.29$ $\sigma^{32}_{rw} = 1.67$ $\sigma^{52}_{rw} = .25$[42]

$\sigma^{13}_{rw} = 1.29$ $\sigma^{33}_{rw} = 1.67$ $\sigma^{53}_{rw} = .25$[43]

$\sigma^{16}_{rw} = 1.29$ $\sigma^{26}_{rw} = 1.29$ $\sigma^{36}_{rw} = 1.67$

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[37] Refers also to the aggregate of both softwood and hardwood products. See Kumar, Table 7.4, p.145.

[38] See L. F. Constantino, Appendix B, p. 105.

[39] See above footnote.

[40] Estimated by the author.

[41] See L. F. Constantino, Appendix B, p.106.

[42] Based on Asia's elasticity of substitution between labor and capital in product i in L. F. Constantino, Appendix B, p.105.

[43] Based on Asia's elasticity of substitution between labor and capital in product i in L. F. Constantino, Appendix B, p.106.

$\sigma_{rw}^{46} = 1.67$ $\sigma_{rw}^{66} = 1.67$[44]

Supply elasticity of factor inputs, α_r^j, α_v^j

$\alpha_r^1 = 0.10$ $\alpha_r^2 = 0.10$ $\alpha_r^3 = 0.10$

$\alpha_r^6 = 0.10$

$\alpha_v^2 = 0.10$ $\alpha_v^3 = 0.10$ $\alpha_v^6 = 0.10$

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[44]See L. F. Constantino, Appendix B, p.105.

APPENDIX C: SENSITIVITY ANALYSIS 1

Doubling Elasticity of Substitution among Products in Japan

Table C.1. Effect on Trade Flow (TF) and Supply Price (SP) of Forest Products in Japan of a 1% Decrease in Ad Valorem Import Tariff on Processed Products by Japan (% Change)

	Forest Product					
	Hdwd Plywood		Hdwd Sawnwood		Hdwd Log	
Country	TF	SP	TF	SP	TF	SP
Indonesia	0.91	0.28	0.19	0.01		
Malaysia	0.67	0.15	0.08	0.02	0.08	0.07
Philippines	0.67	0.14	0.08	0.02	0.04	0.07
Japan	-0.02	-0.10	0.07	-0.09		
	Sfwd Plywood		Sfwd Sawnwood		Sfwd Log	
	TF	SP	TF	SP	TF	SP
U.S.A.	0.20	0.26	.	.	-0.57	-0.57
Canada	0.20	0.26	.	.	-0.57	-1.0
Japan	-0.16	-0.08	-0.11	-0.04	-0.41	-0.18

Table C.2. Effect on Capital Employment (K) and Returns to Capital (r) in Forest Products of a 1% Decrease in Ad Valorem Import Tariff on Processed Products by Japan (% Change)

	Forest Product					
Country	Hdwd Plywood K	r	Hdwd Sawnwood K	r	Hdwd Log K	r
Indonesia	0.09	0.95	0.01	0.13		
Malaysia	0.06	0.63	0.01	0.06	0.01	0.12
Philippines	0.06	0.63	0.01	0.06	0.01	0.06
Japan	-0.01	-0.12	.	-0.04		
	Sfwd Plywood K	r	Sfwd Sawnwood K	r	Sfwd Log K	r
U.S.A.						
Canada						
Japan	-0.02	-0.21	-0.01	-0.10	-0.04	-0.41

Table C.3. Effect on Profitability of Forest Products of a 1% Decrease in Ad Valorem Import Tariff on Processed Products by Japan (% Change)

	Forest Product		
Country	Hdwd Plywood	Hdwd Sawnwood	Hdwd Log
Indonesia	0.0855	0.0013	
Malaysia	0.0378	0.0006	0.0012
Philippines	0.0378	0.0006	0.0006
Japan	-0.0120		
	Sfwd Plywood	Sfwd Sawnwood	Sfwd Log
U.S.A.			
Canada			
Japan	-0.042	-0.0001	-0.0164

Table C.4. Effect on Trade Flow (TF) and Supply Price (SP) of Forest Products in Japan of a 1% Increase in Ad Valorem Export Tax on Hardwood Logs by Malaysia and the Philippines (% Change)

	Forest Product					
	Hdwd Plywood		Hdwd Sawnwood		Hdwd Log	
Country	TF	SP	TF	SP	TF	SP
Indonesia	.	.	.	.		
Malaysia	.	.	.	.	.	.
Philippines	0.06	-0.02	0.03	-0.04	-0.28	-0.26
Japan	.	.	.	.		
	Sfwd Plywood		Sfwd Sawnwood		Sfwd Log	
	TF	SP	TF	SP	TF	SP
U.S.A.	.	.	.	.	.	.
Canada	.	.	.	.	.	.
Japan	.	.	.	.	.	.

Table C.5. Effect on Capital Employment (K) and Returns to Capital (r) in Forest Products of a 1% Increase in Ad Valorem Export Tax on Hardwood Logs by Malaysia and the Philippines (% Change)

	Forest Product					
	Hdwd Plywood		Hdwd Sawnwood		Hdwd Log	
Country	K	r	K	r	K	r
Indonesia	.	.	.	.		
Malaysia	.	.	.	.	.	.
Philippines	.	0.03	.	0.02	-0.04	-0.43
Japan	.	.	.	.		
	Sfwd Plywood		Sfwd Sawnwood		Sfwd Log	
	K	r	K	r	K	r
U.S.A.						
Canada						
Japan	.	.	.	.	.	.

Table C.6. Effect on Profitability of Forest Products of a 1% Increase in Ad Valorem Export Tax on Hardwood Logs by Malaysia and the Philippines (% Change)

	Forest Product		
Country	Hdwd Plywood	Hdwd Sawnwood	Hdwd Log
Indonesia	.	.	
Malaysia	.	.	.
Philippines	.	.	-0.0172
Japan	.	.	
	Sfwd Plywood	Sfwd Sawnwood	Sfwd Log
U.S.A.			
Canada			
Japan	.	.	.

Table C.7. Effect on Trade Flow (TF) and Supply Price (SP) of Forest Products in Japan of a 1% Increase in Ad Valorem Export Tax on Hardwood Logs by Malaysia (% Change)

	Forest Product					
	Hdwd Plywood		Hdwd Sawnwood		Hdwd Log	
Country	TF	SP	TF	SP	TF	SP
Indonesia	0.04	0.01	0.05	.		
Malaysia	0.11	-0.01	0.08	-0.02	-0.29	-0.27
Philippines	0.05	0.01	0.05	0.01	.	.
Japan	-0.08	0.01	-0.07	0.01		
	Sfwd Plywood		Sfwd Sawnwood		Sfwd Log	
	TF	SP	TF	SP	TF	SP
U.S.A.	.	.	.	.	.	.
Canada	.	.	.	.	.	.
Japan	-0.01	.	0.01	.	0.01	.

Table C.8. Effect on Capital Employment (K) and Returns to Capital (r) in Forest Products of a 1% Increase in Ad Valorem Export Tax on Hardwood Logs by Malaysia (% Change)

	Forest Product					
	Hdwd Plywood		Hdwd Sawnwood		Hdwd Log	
Country	K	r	K	r	K	r
Indonesia	.	0.04	.	0.03		
Malaysia	0.01	0.07	.	0.02	-0.04	-0.45
Philippines	.	0.05	.	0.03	.	-0.01
Japan	.	-0.05	.	-0.03		
	Sfwd Plywood		Sfwd Sawnwood		Sfwd Log	
	K	r	K	r	K	r
U.S.A.						
Canada						
Japan	.	.	.	0.01	.	0.01

Table C.9. Effect on Profitability of Forest Products of a 1% Increase in Ad Valorem Export Tax on Hardwood Logs by Malaysia (% Change)

	Forest Product		
Country	Hdwd Plywood	Hdwd Sawnwood	Hdwd Log
Indonesia	.	.	
Malaysia	0.0007	.	-0.018
Philippines	.	.	.
Japan	.	.	
	Sfwd Plywood	Sfwd Sawnwood	Sfwd Log
U.S.A.			
Canada			
Japan	.	.	.

Table C.10. Effect on Trade Flow (TF) and Supply Price (SP) of Forest Products in Japan of a 1% Increase in Ad Valorem Export Tax on Hardwood Logs by the Philippines (% Change)

Country	Forest Product					
	Hdwd Plywood		Hdwd Sawnwood		Hdwd Log	
	TF	SP	TF	SP	TF	SP
Indonesia	.	.	.	.		
Malaysia		.	.	.	.	.
Philippines	0..5	-0.01	0.03	-0.04	-0.28	-0.26
Japan	.	.	.	.		
	Sfwd Plywood		Sfwd Sawnwood		Sfwd Log	
	TF	SP	TF	SP	TF	SP
U.S.A.	.	.	.	.	.	.
Canada	.	.	.	.	.	.
Japan	.	.	.	.	.	.

Table C.11. Effect on Capital Employment (K) and Returns to Capital (r) in Forest Products of a 1% Increase in Ad Valorem Export Tax on Hardwood Logs by the Philippines (% Change)

Country	Forest Product					
	Hdwd Plywood		Hdwd Sawnwood		Hdwd Log	
	K	r	K	r	K	r
Indonesia	.	.	.	.		
Malaysia	.	.	.	.	.	.
Philippines	.	0.03	.	-0.02	-0.04	-0.44
Japan	.	.	.	.		
	Sfwd Plywood		Sfwd Sawnwood		Sfwd Log	
	K	r	K	r	K	r
U.S.A.						
Canada						
Japan	.	.	.	.	.	.

Table C.12. Effect on Profitability of Forest Products of 1% Increase in Ad Valorem Export Tax on Hardwood Logs by the Philippines (% Change)

	Forest Product		
Country	Hdwd Plywood	Hdwd Sawnwood	Hdwd Log
Indonesia	.	.	
Malaysia	.	.	.
Philippines	.	.	-0.0176
Japan	.	.	
	Sfwd Plywood	Sfwd Sawnwood	Sfwd Log
U.S.A.			
Canada			
Japan	.	.	.

Table C.13. Implications of the Trade Model on Land Employment and Returns to Land in Log Products (% Change)

Exogenous change	Effect on land employment		
	Malaysia	Phils	Japan
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	0.01	0.01	-0.04
2. Increase by 1% in ad valorem export tax on hardwood logs by			
Malaysia and Philippines	.	-0.04	.
Malaysia	-0.04	.	.
Philippines		-0.04	.

	Effect on returns to land		
	Malaysia	Phils	Japan
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	0.11	0.05	-0.41
2. Increase of by 1% in ad valorem export tax on hardwood logs by			
Malaysia and Philippines	.	-0.40	.
Malaysia	-0.40	-0.01	.
Philippines	.	-0.40	.

Table C.14. Implications of the Trade Model on Softwood Products from North America (% Change)

Exogenous change	Effect on the trade flow in U.S.A. Plywood	U.S.A. Sawnwood	U.S.A. Logs
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	.	.	.
2. Increase by 1% in ad valorem export tax on hardwood logs by Malaysia and Philippines	.	.	.
Malaysia	.	.	.
Philippines	.	.	.

	Canada Plywood	Canada Sawnwood	Canada Logs
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	.	.	.
2. Increase by 1% in ad valorem export tax on hardwood logs by Malaysia and Philippines	.	.	.
Malaysia	.	.	.
Philippines	.	.	.

Table C.14 (Continued)

Exogenous change	Effect on supply price in U.S.A. Plywood	U.S.A. Sawnwood	U.S.A. Logs
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	.	.	.
2. Increase by 1% in ad valorem export tax on hardwood logs by Malaysia and Philippines	.	.	.
Malaysia	.	.	.
Philippines	.	.	.

	Canada Plywood	Canada Sawnwood	Canada Logs
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	.	.	.
2. Increase by 1% in ad valorem export tax on hardwood logs by Malaysia and Philippines	.	.	.
Malaysia	.	.	.
Philippines	.	.	.

Table C.15. Implications of the Trade Model on Japanese Domestic Forest Products(% Change)

Exogenous change	Effect on the trade flow		
	Hdwd Ply	Hdwd Sawn	
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	-0.02	0.07	
2. Increase by 1% in ad valorem export tax on hardwood logs by Malaysia and Philippines	.	.	
Malaysia	-0.08	-0.08	
Philippines	.	.	
	Sfwd Ply	Sfwd Sawn	Sfwd Log
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	-0.16	-0.11	-0.41
2. Increase by 1% in ad valorem export tax on hardwood logs by Malaysia and Philippines	.	.	.
Malaysia	-0.01	0.01	0.01
Philippines	.	.	.

Table C.15 (Continued)

Exogenous change	Effect on supply price	
	Hdwd Ply	Hdwd Sawn
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	-0.10	-0.09
2. Increase by 1% in ad valorem export tax on hardwood logs by Malaysia and Philippines	.	.
Malaysia	0.01	0.01
Philippines	.	.

	Sfwd Ply	Sfwd Sawn	Sfwd Log
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	-0.08	-0.04	-0.18
2. Increase by 1% in ad valorem export tax on hardwood logs by Malaysia and Philippines	.	.	.
Malaysia	.	.	.
Philippines	.	.	.

Table C.16. Contribution of Forest Products Sector to National Income under Different Scenarios (% Change)

Country/ Scenario	Net Change N. Income	Forest Products Sector		
		Hdwd Ply	Hdwd Sawn	Hdwd Log
Indonesia		(0.52)	(0.56)	
Scenario 1	0.1734	0.1630	0.0104	.
Scenario 2	.	.	.	
Scenario 3	0.0093	0.0069	0.0024	
Scenario 4	.	.	.	
Malaysia		(0.13)	(0.83)	(0.78)
Scenario 1	0.0683	0.0198	0.0104	0.0381
Scenario 2	.	.	.	.
Scenario 3	-0.1372	0.0022	0.0035	-0.1429
Scenario 4	.	.	.	.
Philippines		(0.67)	(1.53)	(0.78)
Scenario 1	0.1403	0.1021	0.0192	0.0190
Scenario 2	-0.1134	0.0049	0.0058	-0.1241
Scenario 3	0.0145	0.0081	0.0096	-0.0032
Scenario 4	-0.1412	0.0049	-0.0064	-0.1397
Japan		(0.05)	(0.13)	
Scenario 1	-0.0057	0.0014	-0.0008	
Scenario 2	.	.	.	
Scenario 3	-0.0008	-0.0006	-0.0006	
Scenario 4	.	.	.	

	Sfwd Ply	Sfwd Sawn	Sfwd Log
	(0.06)	(0.28)	(0.01)
Scenario 1	-0.0014	-0.0043	-0.0006
Scenario 2	.	.	.
Scenario 3	.	0.0004	.
Scenario 4	.	.	.

Numbers in parentheses represent the share of the sector in GDP.

APPENDIX D: SENSITIVITY ANALYSIS 2

Doubling Elasticity of Substitution Between Factors of Production

Table D.1. Effect on Trade Flow (TF) and Supply Price (SP) of Forest Products in Japan of a 1% Decrease in Ad Valorem Import Tariff on Processed Products by Japan (% Change)

	Forest Product					
	Hdwd Plywood		Hdwd Sawnwood		Hdwd Log	
Country	TF	SP	TF	SP	TF	SP
Indonesia	0.69	0.11	0.10	.		
Malaysia	0.38	0.05	0.04	0.01	0.12	0.08
Philippines	0.38	0.05	0.04	0.01	0.05	0.08
Japan	-0.03	-0.11	0.10	-0.10		
	Sfwd Plywood		Sfwd Sawnwood		Sfwd Log	
Country	TF	SP	TF	SP	TF	SP
U.S.A.	.	.	.	.	.	.
Canada	.	.	.	.	.	.
Japan	-0.24	-0.05	-0.07	-0.02	-0.53	-0.12

Table D.2. Effect on Capital Employment (K) and Returns to Capital (r) in Forest Products of a 1% Decrease in Ad Valorem Import Tariff on Processed Products by Japan (% Change)

	Forest Product					
	Hdwd Plywood		Hdwd Sawnwood		Hdwd Log	
Country	K	r	K	r	K	r
Indonesia	0.04	0.37	.	0.03		
Malaysia	0.02	0.19	.	0.02	0.01	0.13
Philippines	0.02	0.19	.	0.02	0.01	0.06
Japan	-0.01	-0.12	-0.01	-0.07		
	Sfwd Plywood		Sfwd Sawnwood		Sfwd Log	
	K	r	K	r	K	r
U.S.A.						
Canada						
Japan	-0.01	-0.14	.	-0.04	-0.03	-0.28

Table D.3. Effect on Profitability of Forest Products of a 1% Decrease in Ad Valorem Import Tariff on Processed Forest Products by Japan (% Change)

	Forest Product		
Country	Hdwd Plywood	Hdwd Sawnwood	Hdwd Log
Indonesia	0.0148	.	
Malaysia	0.0038	.	0.0013
Philippines	0.0038	.	0.0006
Japan	-0.0012	-0.0007	
	Sfwd Plywood	Sfwd Sawnwood	Sfwd Log
U.S.A.			
Canada			
Japan	-0.0014	.	-0.0084

Table D.4. Effect on Trade Flow (TF) and Supply Price (SP) of Forest Products in Japan of a 1% Increase in Ad Valorem Export Tax on Hardwood Logs by Malaysia and the Philippines (% Change)

	Forest Product					
	Hdwd Plywood		Hdwd Sawnwood		Hdwd Log	
Country	TF	SP	TF	SP	TF	SP
Indonesia	.	.	.	.		
Malaysia	.	.	.	.	.	.
Philippines	0.05	-0.03	0.01	-0.04	-0.44	-0.28
Japan	.	.	.	.		
	Sfwd Plywood		Sfwd Sawnwood		Sfwd Log	
	TF	SP	TF	SP	TF	SP
U.S.A.	.	.	.	.	.	.
Canada	.	.	.	.	.	.
Japan	.	.	.	.	.	.

Table D.5. Effect on Capital Employment (K) and Returns to Capital (r) in Forest Products of a 1% Increase in Ad Valorem Export Tax on Hardwood Logs by Malaysia and the Philippines (% Change)

	Forest Product					
	Hdwd Plywood		Hdwd Sawnwood		Hdwd Log	
Country	K	r	K	r	K	r
Indonesia	.	.	.	.		
Malaysia	.	.	.	.	.	.
Philippines	.	.	.	-0.04	-0.05	-0.46
Japan	.	.	.	.		
	Sfwd Plywood		Sfwd Sawnwood		Sfwd Log	
	K	r	K	r	K	r
U.S.A.						
Canada						
Japan	.	.	.	.	.	.

Table D.6. Effect on Profitability of Forest Products of a 1% Increase in Ad Valorem Export Tax on Hardwood Logs by Malaysia and the Philippines (% Change)

	Forest Product		
Country	Hdwd Plywood	Hdwd Sawnwood	Hdwd Log
Indonesia	.	.	
Malaysia	.	.	.
Philippines	.	.	-0.023
Japan	.	.	
	Sfwd Plywood	Sfwd Sawnwood	Sfwd Log
U.S.A.			
Canada			
Japan	.	.	.

Table D.7. Effect on Trade Flow (TF) and Supply Price (SP) of Forest Products in Japan of a 1% Increase in Ad Valorem Export Tax on Hardwood Logs by Malaysia (% Change)

	Forest Product					
Country	Hdwd Plywood TF	SP	Hdwd Sawnwood TF	SP	Hdwd Log TF	SP
Indonesia	0.09	0.01	0.05	.		
Malaysia	0.14	-0.02	0.07	-0.04	-0.42	-0.28
Philippines	0.09	0.01	0.05	.	.	.
Japan	-0.14	0.02	-0.08	0.03		
	Sfwd Plywood TF	SP	Sfwd Sawnwood TF	SP	Sfwd Log TF	SP
U.S.A.	.	.	0.01	0.02	0.01	0.01
Canada	.	.	0.01	0.04	.	0.02
Japan	-0.01	.	0.01	.	0.01	.

Table D.8. Effect on Capital Employment (K) and Returns to Capital (r) in Forest Products of a 1% Increase in Ad Valorem Export Tax on Hardwood Logs by Malaysia (% Change)

	Forest Product					
	Hdwd Plywood		Hdwd Sawnwood		Hdwd Log	
Country	K	r	K	r	K	r
Indonesia	.	0.05	.	0.02		
Malaysia	.	0.04	.	0.02	-0.04	-0.45
Philippines	.	0.05	.	0.02	.	-0.02
Japan	.	-0.03	.	0.01		
	Sfwd Plywood		Sfwd Sawnwood		Sfwd Log	
	K	r	K	r	K	r
U.S.A.						
Canada						
Japan	.	.	.	0.01	.	0.01

Table D.9. Effect on Profitability of Forest Products of a 1% Increase in Ad Valorem Export Tax on Hardwood Logs by Malaysia (% Change)

	Forest Product		
Country	Hdwd Plywood	Hdwd Sawnwood	Hdwd Log
Indonesia	.	.	
Malaysia	.	.	-0.018
Philippines	.	.	.
Japan	.	.	
	Sfwd Plywood	Sfwd Sawnwood	Sfwd Log
U.S.A.			
Canada			
Japan	.	.	.

Table D.10. Effect on Trade Flow (TF) and Supply Price (SP) of Forest Products in Japan of a 1% Increase in Ad Valorem Export Tax on Hardwood Logs by the Philippines (% Change)

	Forest Product					
	Hdwd Plywood		Hdwd Sawnwood		Hdwd Log	
Country	TF	SP	TF	SP	TF	SP
Indonesia	.	.	.	.		
Malaysia	.	.	.	.	.	.
Philippines	0.05	-0.03	0.01	-0.04	-0.44	-0.28
Japan	.	.	.	.		
	Sfwd Plywood		Sfwd Sawnwood		Sfwd Log	
	TF	SP	TF	SP	TF	SP
U.S.A.	.	.	.	.	.	.
Canada	.	.	.	.	.	.
Japan	.	.	.	.	.	.

Table D.11. Effect on Capital Employment (K) and Returns to Capital (r) in Forest Products of a 1% Increase in Ad Valorem Export Tax on Hardwood Logs by the Philippines (% Change)

	Forest Product					
	Hdwd Plywood		Hdwd Sawnwood		Hdwd Log	
Country	K	r	K	r	K	r
Indonesia	.	.	.	.		
Malaysia	.	.	.	.	.	.
Philippines	.	.	.	-0.03	-0.05	-0.45
Japan	.	.	.	.		
	Sfwd Plywood		Sfwd Sawnwood		Sfwd Log	
	K	r	K	r	K	r
U.S.A.						
Canada						
Japan	.	.	.	.	.	.

Table D.12. Effect on Profitability of Forest Products of 1% Increase in Ad Valorem Export Tax on Hardwood Logs by the Philippines (% Change)

	Forest Product		
Country	Hdwd Plywood	Hdwd Sawnwood	Hdwd Log
Indonesia	.	.	
Malaysia	.	.	.
Philippines	.	.	-0.023
Japan	.	.	
	Sfwd Plywood	Sfwd Sawnwood	Sfwd Log
U.S.A.			
Canada			
Japan	.	.	.

Table D.13. Implications of the Trade Model on Land Employment and Returns in Log Products (% Change)

Exogenous change	Effect on land employment		
	Malaysia	Phils	Japan
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	0.01	0.01	-0.03
2. Increase by 1% in ad valorem export tax on hardwood logs by			
Malaysia and Philippines	.	-0.05	.
Malaysia	-0.04	.	.
Philippines		-0.05	.

	Effect on returns to land		
	Malaysia	Phils	Japan
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	0.13	0.05	-0.28
2. Increase of by 1% in ad valorem export tax on hardwood logs by			
Malaysia and Philippines	.	-0.46	.
Malaysia	-0.44	0.02	0.01
Philippines	.	-0.46	.

Table D.14. Implications of the Trade Model on Softwood Products from North America (% Change)

Exogenous change	Effect on the trade flow		
	Plywood	U.S.A. Sawnwood	Logs
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	.	.	.
2. Increase by 1% in ad valorem export tax on hardwood logs by			
Malaysia and Philippines	.	.	.
Malaysia	.	.	.
Philippines	.	.	.
	Plywood	Canada Sawnwood	Logs
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	.	.	.
2. Increase by 1% in ad valorem export tax on hardwood logs by			
Malaysia and Philippines	.	.	.
Malaysia	.	.	.
Philippines	.	.	.

Table D.14 (Continued)

Exogenous change	Effect on supply price		
	Plywood	U.S.A. Sawnwood	Logs
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	.	.	.
2. Increase by 1% in ad valorem export tax on hardwood logs by Malaysia and Philippines	.	.	.
Malaysia	.	.	.
Philippines	.	.	.
	Plywood	Canada Sawnwood	Logs
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	.	.	.
2. Increase by 1% in ad valorem export tax on hardwood logs by Malaysia and Philippines	.	.	.
Malaysia	.	.	.
Philippines	.	.	.

Table D.15. Implications of the Trade Model on Japanese Domestic Forest Products(% Change)

Exogenous change	Effect on the trade flow	
	Hdwd Ply	Hdwd Sawn
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	-0.03	0.10
2. Increase by 1% in ad valorem export tax on hardwood logs by Malaysia and Philippines	.	.
Malaysia	0.02	0.03
Philippines	.	.

	Sfwd Ply	Sfwd Sawn	Sfwd Log
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	-0.24	-0.07	-0.53
2. Increase by 1% in ad valorem export tax on hardwood logs by Malaysia and Philippines	.	.	.
Malaysia	.	.	.
Philippines	.	.	.

Table D.15 (Continued)

Exogenous change	Effect on supply price		
	Hdwd Ply	Hdwd Sawn	
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	-0.11	-0.10	
2. Increase by 1% in ad valorem export tax on hardwood logs by Malaysia and Philippines	.	.	
Malaysia	-0.14	-0.08	
Philippines	.	.	
	Sfwd Ply	Sfwd Sawn	Sfwd Log
1. Decrease by 1% in ad valorem import tariff on processed products by Japan	-0.05	-0.02	-0.12
2. Increase by 1% in ad valorem export tax on hardwood logs by Malaysia and Philippines	.	.	.
Malaysia	-0.01	0.01	0.01
Philippines	.	.	.

Table D.16. Contribution of Forest Products Sector to National Income under Different Scenarios (% Change)

Country/ Scenario	Net Change N. Income	Forest Products Sector		
		Hdwd Ply	Hdwd Sawn	Hdwd Log
Indonesia		(0.52)	(0.56)	
Scenario 1	0.0659	0.0635	0.0024	.
Scenario 2	.	.	.	
Scenario 3	0.0102	0.0086	0.0016	
Scenario 4	.	.	.	
Malaysia		(0.13)	(0.83)	(0.78)
Scenario 1	0.0508	0.0060	0.0035	0.0413
Scenario 2	.	.	.	.
Scenario 3	-0.1381	0.0013	0.0035	-0.1429
Scenario 4	.	.	.	.
Philippines		(0.67)	(1.53)	(0.78)
Scenario 1	0.0562	0.0308	0.0064	0.0190
Scenario 2	-0.1588	.	-0.0128	-0.1460
Scenario 3	0.0087	0.0081	0.0064	-0.0058
Scenario 4	-0.1525	.	-0.0096	-0.1429
Japan		(0.05)	(0.13)	
Scenario 1	-0.0058	-0.0014	-0.0014	
Scenario 2	.	.	.	
Scenario 3	0.0004	.	0.0004	
Scenario 4	.	.	.	

	Sfwd Ply	Sfwd Sawn	Sfwd Log
	(0.06)	(0.28)	(0.01)
Scenario 1	-0.0009	-0.0017	-0.0004
Scenario 2	.	.	.
Scenario 3	.	.	.
Scenario 4	.	.	.

Numbers in parentheses represent the share of the sector in GDP.