AN ABSTRACT OF THE THESIS OF

Jeremias A. Canonizado for the degree of Doctor of Philosophy in Forest Management presented on May 5, 1986.

Title: A Policy Model for Philippine Timber Product Exports

Abstract approved: [signature]
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The Philippines relies heavily on timber product exports for its foreign exchange requirements. In recent years, however, it adopted log export restrictions as a hedge against the rapid depletion of its timber resources. Although conducted independently, its ASEAN partners (Malaysia and Indonesia), have likewise instituted similar restrictions on their own log exports. Considering the major role of these countries in world hardwood production and trade, these policy developments have become a major concern among the hardwood consuming regions, especially the major importers of hardwood logs like Japan and the Asian entrepots. It is necessary to model the linkages among the various hardwood producing and consuming regions in order to effectively evaluate the effects of specific trade and forest policies initiated by the key producers like the Philippines, Malaysia, and Indonesia. The

dearth of previous knowledge and effort in this field prompted the development of such a model.

The resulting spatial model consisting of 36 supply and demand equations was used to simulate the short-run effects of several trade and forest policies initiated by the Philippines and ASEAN. Using purely economic criteria, the results indicate that the Philippines will not gain from banning its log exports, but would benefit immensely if ASEAN enforced a log export embargo.

Additional tariffs on Philippine timber exports discourage product exports but encourage raw log exportation. Removing the current 4% export tax improves the Philippines trading position at the expense of its ASEAN partners.

Simulating the possibility of the ASEAN producers trading with each other indicates they could mutually and simultaneously benefit from such a policy.

A major Philippine currency devaluation demonstrates the "beggar thy neighbor" effect through Malaysia and Indonesia suffering immensely from the induced price-reduction of Philippine products.

The results of the 13 simulations reveal insights on the mechanics of the interactions between the trading regions and confirm the strong interdependence that exists between the Philippines and its ASEAN neighbors.

A Policy Model for Philippine Timber Product Exports

by

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A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Doctor of Philosophy

Completed May 5, 1986

Commencement June 1987

ACKNOWLEDGEMENTS

I wish to express my sincere appreciation and deep gratitude to the following individuals who have helped me during my graduate study at Oregon State University:

To Dr. Darius M. Adams, my major professor, for his advice, and understanding, and for his remarkable achievements in this field of research which served as my guidance and inspiration;

To Dr. Charles F. Sutherland, my former adviser, who graciously bowed out at Chairman of my Committee in order to permit Dr. Adams to assume a more active role in my dissertation work. I shall forever be indebted to him for his kindness and genuine concern for my welfare while at OSU;

To Dr. Ray Charles Vars, Jr., a member of my Committee, whose searching insights in any intellectual undertaking, prompted me to improve upon the quality of this work;

To Dr. J. Douglas Brodie for his guidance, valuable criticisms and suggestions, and for his genuine concern for my personal welfare;

To Dr. John Bell, a member of my Committee, for his valuable criticisms and moral support;

To Dr. Thomas Bedell, my Graduate School Representative, for his understanding and genuine interest in my work;

To Jim Boyle, my Department Chairman, for his support and understanding;

To Lisa Haven for giving moral support when she herself needed more of it;

To USAID and the Philippine Council for Agricultural Research for making this grant possible;

Special thanks go to the following persons for their equally special contributions:

To Dr. Filiberto S. Pollisco, my boss in the Philippines, for his great faith in me;

To Rolly Metin, my friend in FORI who attended to the official requirements of my extended stay in the US, and for looking after my position in FORI in my absence;

To Lita Reyes for handling my finances in my absence, and for typing the original copy of this thesis;

To Nena Giron, Lettie Pilando and Jill Almendras for their undivided support in the reproduction of this work; and

Finally, to my wife, Lita, for her incessant prodding, without which this would would never have been finished.

To my wife, LITA, and our daughter, FRANCES,
I dedicate this modest contribution to forestry.

J.A. Canonizado

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

A POLICY MODEL FOR PHILIPPINE TIMBER PRODUCT EXPORTS

CHAPTER I

INTRODUCTION

Timber products (logs, lumber, veneer and plywood) are traditional exports of the Philippines. Together, they account for some 17% of the country's receipts from all traditional exports including copra, copper, sugar, and nickel. In 1976, these receipts totalled US$270 million and in 1981, this came to US$314 million despite record downswings in worldwide demand during the 1980-82 recession (BFD, 1977, 1982). Direct employment in forestry and wood industries in 1981 was placed at 95,000 with total dependents estimated at 500,000. In GNP terms, forestry and wood products contributed 3.67% in 1981, 3.73% in 1980, and 3.56% in 1979 (MNR Annual Report, 1981).

Forestry in the Philippines: An Historical Backdrop

Forest policy and administration dates back to 1893, when the Spanish colonial government organized the forest service known as the Inspeccion General de Montes under the Direccion General de Administracion Civil. The primary functions of this office were to inspect and study the forest resources to form the basis for policy, rules, and regulations in the disposition and use of the forest resources of the colony. The embodying principle of forest policy had always been "conservationist", considering the desire of Spain to maintain a continuous supply of shipbuilding materials to sustain the flourishing Galleon Trade between Manila and Acapulco (Sulit, 1959).

After the defeat of Spain by the United States in 1898, the Philippines was placed under the American Military Government. Forest administration proceeded with the establishment of the Forestry Bureau in 1900 from the foundations built by the Spaniards. A definite policy towards conservation was accomplished by the Philippine Bill of July 1, 1902 (Act of Congress) and the Forest Act (Act 1148) enacted by the Philippine Commission on May 7, 1904. The conservationist policy declarations of the Pinchot era in the United States spread to the Philippines. Act 2711 of 1917 known as the Revised Administrative Code broadly mandated that the public forests of the Philippines "shall be held and administered for the protection of the public interest, the utility and safety of the forest, and perpetuation thereof in productive condition of wise use" (Hyman, 1983).

The establishment of the Commonwealth Government in 1935 carried on the progressive trend towards self-government. This period was characterized by strong efforts towards reforestation (Act 304 known as the "Reforestation Law"), land classification, resource inventory (Act 347 or the "Land

Classification, Survey and Subdivision Law"), and forest protection (Act 447 known as the "Kaingin Law" declaring it unlawful to conduct shifting cultivation activities in the public domain).

Over a brief period in 1942-1944, the Japanese took control over the management of the forest service. Hampered by the resistance, the Japanese got very little in their efforts to exploit the country´s resources. In the ensuing food shortages brought about by the disruption of agriculture and industry, the Japanese permitted people to raise food in all available public and private lands (public forest included), thus laying waste the protection efforts of the previous American regime. By exercising total control over forest licensing and distribution of products, the Japanese also curtailed the then flourishing lumber industry (Sulit, 1959).

The post-war era in Philippine forestry was characterized by massive rehabilitation efforts and restructuring the forest service now known as the Bureau of Forestry, following the declaration of Philippine Independence in 1946. The coming years would open new horizons for Philippine forestry--most notably an active and favorable trading partnership with the United States, and the rapid growth of the forest products industries. These years would also usher in major problems in trade and forest protection.

A Brief History of Trade in Forest Products

It has been claimed that the Philippines was trading actively with its Asian neighbors long before the Spaniards stumbled over the Philippines in 1521. Under the regime of Spain, hardwood lumber from the Philippines found its way to the mother country and her colonies via the Galleon trade. During the initial period of American colonization in the early 1900's, lumber had to be imported from the United States to sustain reconstruction efforts. Because of the restrictive provisions of the Spooner Amendment, it took some time before logging operations could be undertaken by the interim colonial government (Sulit, 1959). The following decades would mark the strengthening of trade relations and defining the terms of free trade between the Philippines and the United States. In 1909, the Payne-Aldrich Tariff Act provided for decreasing tariffs and set quotas on some Philippine products shipped to the U.S. In 1913, these quotas were removed by the Underwood-Simons Tariff Act. This act would eventually spell the terms of free trade and product specialization between these countries for the next two decades (Umali and Gamboa, 1979).

With the declaration of Philippine independence in 1946, the terms of trade between these two nations had to be redefined. This was embodied in the Philippine Trade Act of 1946 amended later by the Laurel-Langley Agreement of 1955 which provided for a schedule of free trade followed by increasing tariffs at the rate of 5% per year until normal tariffs were imposed on each nation's exports by 1973. The Laurel-Langley Agreement would later on prove to be the main irritant in US-Philippine relations. It provided for a "parity clause" which permitted citizens of the United States to exploit the country's natural resources. This clause allowed the United States to take control of the Philippines' timber resources and guarantee the continuous flow of timber product exports to the U.S. until its termination in 1974 (Umali and Gamboa, 1979).

The emergence of Japan as a trading partner of the Philippines started soon after World War II when Japan agreed to pay war reparations of $800 million over a 20-year period, $250 million of which were commercial loans. These reparations payments created for Japan various economic linkages that would survive even the bitter antagonism of the Filipinos towards their World War II conqueror (Umali and Gamboa, 1979). Table 1a shows the aggressive log trade between Japan and the Philippines before 1976 when the Philippines unilaterally restricted the exportation of unprocessed logs. This strengthening of trade relations is even more evident in lumber trade. Meanwhile, Philippine-American trade in these products has gradually become less important to both countries, as witnessed by the declining trend in the volume of Philippine exports of plywood and veneer sheets to the U.S. As early as 1970, the Philippines was already creating inroads into the Western European market as evidenced by the consistent rise in plywood and lumber exports to the major industrial countries of that continent (see Table 1a).

Table 1a - Volume of Exports of Philippine Timber Products to Japan, USA, and Western Europe* (1964-1980) (All units in cubic meters)

Year	Logs to	Plywood to		Lumber to		Veneer to		
	Japan	USA	W.Eur	Japan	USA	W.Eur	Japan	USA
1964	4621	153	-	-	-	-	-	-
1966	6716	171	-	-	-	-	-	-
1968	5964	258	-	18	53	1	3	135
1970	6362	246	3	47	40	8	7	102
1972	5270	277	7	42	65	9	12	199
1974	3730	78	8	-	91	39	11	111
1976	1553	160	61	49	85	262	6	128
1978	1511	na	na	106	74	284	10	27
1980	1154	166	106	199	80	330	5	18

Source: FAO Yearbook of Forest Products (1964-1975) (1970, 1981)

*Western Europe in this table includes only Netherlands, Germany, France, U.K., and Belgium.

Geographic and Institutional Settings

The Philippines is an archipelago of some 7,000 islands with a total land area of 30 million hectares. It lies towards the southeastern rim of the Asian mainland and forms the eastern boundary of the southeast Asian region. It lies wholly within the tropics and receives about a third of its annual precipitation from typhoons. Annual rainfall varies from 150 to 450 cms. About 42% of the land is classified forest with six broad types - Dipterocarp, Molave (Vitex sp.), pine, mangrove, beach or littoral, and mid-mountain/mossy. The Dipterocarp forest which thrives on elevations below 800 meters is the most important type--producing the timber group dipterocarps which is believed to be endemic to the Southeast Asian region. The great bulk of all Southeast Asian timber production and trade consists of the dipterocarps - known in the hardwood market as Lauan (Philippines), Meranti and Mersawa (Malaysia and Indonesia). More than 90% of all traded Southeast Asian timber are species of the genera Shorea, Dipterocarpus, and Pentacme (Wyatt-Smith, 1979). The Lauan timber that originates from the Philippines bears the trade name Philippine Mahogany, after the group of seven Shorea species that produce more than 70% of all sawlogs produced in the Philippines. Close to 98% of all forest lands in the Philippines are owned by the state. Fixed term licences (for 25 years, renewable for another 25 years) are issued to private enterprise in the harvesting and development of the forest resource.

Forest policy is embodied in the Revised Forestry Code of the Philippines (Presidential Decree 705 as amended by P.D. 1559) and is basically characterized broadly as follows:

1. Orientation of multiple uses of forest land towards national development and the public welfare;

2. Encouragement and rationalization of wood processing; and

3. Perpetuation of forest lands in productive condition.

The policy making process is initiated at the executive level by the Ministry of Natural Resources. The administrative arm of forest policy is the Bureau of Forest Development (formerly Bureau of Forestry). The responsibility of promulgating and implementing the provisions of the Forestry Code lies principally in these two agencies.

Other public and private entities participate in the policy making and evaluation process by mandate or representation. The major agencies that fall in this category are the Forest Research Institute (FORI), the Forest Products Research and Industries Development Commission (FORPRIDECOM), the Philippine Council for Agricultural Research and Development (PCARD), the Natural Resources Management Center (NRMC), the Presidental Committee on Wood Industries Development (PCWID), and the University of the Philippines at Los Baños, College of Forestry (UPLB-CF). Private institutions are mainly interest groups in the logging and wood processing sectors, but take active part, nevertheless, in policy matters.

Philippine Performance in Hardwood Production and Trade

The Philippines, Malaysia, and Indonesia, together are the world's largest producer of non-coniferous timber. In 1978, their combined production of dipterocarp logs accounted for 26% of world production of non-coniferous logs (65% of all non-coniferous logs produced in Asia). Of this combined production in 1978, the Philippines contribued only 11%, compared to 17% in 1973, and 31% in 1969 (FAO, 1979). This downward trend is likewise reflected in log exports. In 1968, these countries accounted for 98% of all Asian log exports in non-coniferous logs, the Philippines contributing 39%. This became 20% in 1973 and a mere 6% in 1978. Prior to 1976, the low performance of the Philippines may be attributed to the opening of Kalimantan frontier in Indonesia and the intensification of logging activities in Malaysian states of Sabah and Sarawak. The Indonesian experiment in Kalimantan diverted a considerable but undisclosed amount of Philippine capital and expertise as investors were attracted to the profitable prospect of pioneering the exploitation of this vast timber resource. In 1976, the Philippines unilaterally restricted the exportation of unprocessed logs with the objective of developing its wood processing capability and conserving its productive forests for posterity. This log export restriction is explicitly provided for by law, i.e., Section 32 of Presidental Decree No. 1559 of 1976, which commits the total production of logs to local processing, but provides up to 25% of the allowable cut for export.

In 1981, six years after the log export restriction was initiated, the Philippines was exporting 77% more lumber, 135%

more plywood, and 39% more veneer than the pre-restriction year 1975.

Processing capacity did not increase during the same period, however. In 1981, there were only 182 sawmills with a daily rated capacity (d.r.c.) of 9,765 cubic meters. Likewise, there were 33 plywood and veneer mills in 1981 with a d.r.c. of 5,238 cu.m. against 49 in 1974 with a d.r.c. of 6,330 cu.m. The decrease in capacity is due largely to shutdowns after the implementation of the log export restrictions as most of the previous log exporters operated at least a sawmill in compliance with license requirements. The cancellation of timber licenses and permits to operate wood processing plants following the performance evaluation of timber licenses in 1978-1980 also contributed substantially to this decrease in processing capacity.

The ASEAN Timber Products Market

Domestic developments in the Philippine forestry sector are a matter of interest to Malaysia and Indonesia, which together with Thailand, Singapore, and the Philippines, form the trade treaty called ASEAN or Association of Southeast Asian Nations. Although they are trade partners, these countries (especially the triad of the Philippines, Malaysia, and Indonesia) are fierce rivals in the forest products trade. They produce basically the same products (dipterocarp hardwood products); they share practically the same markets (Japan, USA, Western Europe, Korea, other Asian entrepots); they are all strongly linked to the Japanese economy (for example, combined log exports for 1968-1979 totalled 374 million cu.m., more than 60% of which went to Japan); and, they are people from the same racial stock, hence they have basic similarities in culture and sentiment. They are also developing economies with a large labor base.

Through the late fifties and sixties, the Philippines closely rivaled Malaysia in dominating the region in the production of and trade in forest products. It was during the later part of this period that Indonesia began to develop its enormous forest resources in Kalimantan and Celebes (Booth, 1980). By 1972, Indonesia had overtaken Malaysia and the Philippines in log trade, exporting 43% of combined exports in logs. The close cooperation among these nations in commerce, education, and defense in later years gradually evolved the hardwood cartel of Southeast Asia. The Philippines led the group in restricting log exports, approving the move in 1972 and finally implementing it in 1976. More recently, Malaysia and Indonesia have followed suit. Although Peninsular Malaysia (also called West Malaysia) was the first to successfully ban log exports in 1972, its move was not internationally felt as it was catering principally to only one market, Singapore, and the volume of its log exports was small relative to the country as a whole. The bulk of Malaysian log production originates from the eastern states of

Sabah and Sarawak. In 1979, the governments of these states decided to gradually reduce log exports through a schedule of export quotas. As an added measure, the royalties were sharply increased, raising the government's revenue share of the f.o.b. price from 32% to 60%. Around 1978, Indonesia started to seriously pursue its long-established goal of developing its wood processing sector. Its strategy consisted initially of a series of log export tariffs in 1978-1979. In 1980, the government used log export quota allocations to "coerce" timber licensees into performing actively the wood processing stipulations of their contracts. For Indonesia, at least, this determination has brought in superb results. The 1981 log exports figures for the country decreased sharply, while plywood production and exports dramatically increased from the country's net importer status in 1974 to the region's dominant producer and exporter of plywood in 1981 (World Bank, 1984).

This "cartel-like" behaviour of these countries in log trade has likewise found its way into the plywood sectors. In December 1982, the ASEAN Panel Products Federation fixed prices of wood panels exported to Western Europe (Bulletin Today, December 17, 1982). Although it was acknowledged that the agreed prices were not binding in the absence of penalties to violators, this event is a barometer of the foreseeable atmosphere of cooperation that is bound to take place in the region. More than the initial success of their willingness to cooperate by themselves, these actions have a singular implication that these countries have finally ironed out their traditional and historical discords notably between Malaysia and Indonesia during the Sukarno years, and between Malaysia and the Philippines (over the territorial claims to Sabah) in the early sixties. These ties are gradually being strengthened by the region's solidarity in warding off a common communist expansionist threat through Vietnam, and a growing sense of identity and pride in their common racial heritage. In the long run, these sentiments may prove to be forces more powerful than any combined or concerted short-run economic action they might undertake in the present.

Problems of Philippine Wood Exports

The policy of log export restrictions brought to fore many of the problems facing the Philippine wood industry. As a result of an early effort of the Philippine government in 1967 to encourage widespread wood processing, small scale licenses were integrated and required to put up wood processing facilities close to the timber source. The big number of sawmills put up during this period is not necessarily indicative of a vigorous national effort towards processing. Many of these mills were apparently put up in compliance with regulations in order to engage in the more profitable log export business (Sanvictories, 1979; Segura-delos Angeles, 1981).

The restriction of log exports was not accompanied by a concerted effort on the part of the government to create incentives for the log producers to make the transition to intensified wood processing. Tight monetary policies made it extremely difficult for log producers to import new and replacement machinery necessary in the expansion of wood processing capability. Retention schemes to assure sufficiency of domestic materials were also imposed on all exportable goods. The Export Stabilization Tax (P.D. 230), which imposed a 4% tax on all exported wood products, domestic taxes on inputs, and wage control-all created, instead, disincentives to domestic wood processing (Umali and Gamboa, 1979; Segura-delos Angeles, 1981). The most recent restriction was the designation of 8 ports as the only exit points for log exports. Due to disparities in the trade figures reported by Japanese importers and official figures released by the government, authorities have come to the conclusion that some 1.05 million cu.m. of logs were illegally exported in 1981 (Philippines Daily Express, January 13, 1983). This move is almost certain to increase log transport and ocean freight costs for log exports, and therefore deteriorate further the Philippines' competitive position.

The wood based panels industry had been over-dependent on the U.S. market because of preferential treatment under various trade agreements between the two countries. In 1968, the U.S. market was absorbing about 98% of all plywood exports from the Philippines. This figure has consistently dropped since then, down to 70% in 1975 and to 50% in 1981. This decline was the result of the normalization of tariffs after the termination of the Laurel-Langley Agreement in 1974 and the emergence of Korea and Taiwan as major suppliers of hardwood plywood (produced from Southeast Asian hardwood logs) to the U.S. The obvious disadvantage of this historical over-dependence on the U.S. market had been the time and opportunity lost by the Philippines in seeking out alternative markets for its products.

Objectives and Scope of the Study

The importance of the tropical supplies of hardwood today transcends purely economic considerations. The structure of their ownership and management is often of great sociological value to agencies (such as the World Bank) that are engaged in well-balanced programs of national development. The ecological impact of rapid deforestation in tropical regions is a major concern plaguing scientists today (Steinlin, 1982).

This study is limited to the purely economic aspects of the tropical hardwood products trade especially as it touches upon the specific roles of the Philippines and its ASEAN partners.

The primary objective of this study is to develop a trade model of the tropical timber products trade with specific treatment of the Philippines as a major producer. The model will be used to examine the following current trade and forest policy issues:

1. Impacts of log export restrictions imposed by the major tropical log producers (e.g., the Philippines in 1976 and Indonesia in 1980). An extended scenario in the light of the current atmosphere of regional cooperation in ASEAN is the simultaneous restriction of log exports by all three producers - Malaysia, Indonesia, and the Philippines. This multilateral restriction will be simulated and its global and regional effects determined.

2. Tariff alternatives to quantitative restrictions on log exports . Rather than physically restrict the flow of export logs, export tariffs may well accomplish the same objectives the log export ban is expected to achieve. The model will simulate the effect of various export tariffs imposed by the Philippines on its timber exports.

3. Trade liberalization in ASEAN . For the Philippines, at least, self sufficiency in products is not explicitly pronounced as a goal of forest policy, but seems implied in past government actions and directions of trade policy. Amid a large resource base and a traditional export market, this policy has been taken for granted in the past. It is currently conceded that the Philippines has rapidly run down its timber resources. Probably because of the abundance of timber resources in the Southeast Asian region, the major producers (Malaysia, Indonesia, and the Philippines) never actively traded in logs and products among themselves. The model will attempt to explore the possibility of liberalizing trade among the ASEAN timber producers.

4. Exchange rate effect . In the face of the current devaluation of the Philippine peso against the U.S. dollar (pre 1984 rate was 10 to 1; in 1985, the rate became 17 to 1), it is not totally clear if Philippine products will perform better or worse than the competition in

the short run. The model will try to simulate the effects of this Philippine currency devaluation on global trade in timber products.

Importance of the Model

The model will be primarily used as an instrument for policy evaluation of the forestry sector in the Philippines. In its basic configuration, it could serve as a planning tool for regional (ASEAN) cooperation, whereupon the ASEAN Ministerial and Sub-ministerial Panels on trade, as well as the commodity alliance groups, Southeast Asian Lumber Producers Association (SEALPA), and the ASEAN Panel Products Federation could be directly benefited.

With slight modification, it can serve as a planning tool for (domestic) economic development through the evaluation of policies that affect domestic programs like housing development and reforestation.

By improving upon the specification of the supply side equations, the model should find direct and immediate use in forecasting timber trends and prospects for the Philippines and its ASEAN partners. This model is probably the first formal attempt to model global trade in tropical hardwood products. The most successful attempts at trade modeling (e.g., the 1980 Timber Assessment Market Model) are confined to softwood timber. None of the econometric works on hardwood trade take the entire spectrum of tropical hardwood markets and products simultaneously in perspective. This model is therefore a contribution to future modeling efforts in this important but hitherto neglected aspect of international timber products trade.

CHAPTER II

REVIEW OF LITERATURE

Modeling Timber Trade in General: A Review of Methods

To provide background for the development of the present model, this section reviews the methodology of modeling trade flows according to the degree of aggregation/disaggregation of markets only. Towards this end, models shall be classified as non-spatial models or those that possess the usual demand and supply relations and a corresponding adjustment mechanism towards an equilibrium solution but treat the problem in the context of a single market, and spatial models or those models that take into account fully or partly, both the horizontal interactions between several markets and the vertical relationships between product and factor markets. Models in each class may be categorized by their solution method, econometric or programming. Econometric models treat each individual flow path as if a different product were being traded each time. To describe each and every trade flow relationship will therefore require a large number of structural relations. The data requirements are necessarily substantial even for a very simple problem. Econometric models, however, are extremely flexible in dealing with a wide range of trade flow patterns -

especially in dealing with "cross-hauls" or simultaneous shipment of the same category of commodities between two regions, and the "inertia" of changes in these flow patterns (Adams, 1982).

On the other hand, programming models employ an optimization process to arrive at a market equilibrium solution. Assumptions about the behavior of suppliers and demanders are incorporated in the objective function to be minimized or maximized subject to an array of physical, technological, and flow constraints. The data requirements in programming models are far less extensive than those of the econometric approach. Consequently, programming models are less flexible.

Non-Spatial Models

In this type of model, suppliers and demanders act as if they are operating in a single market disregarding differences in prices form product origin to receiving point. Total demand for and supply of a product or group of products are usually estimated as single-equation relationships. A typical recent model of this type is the work of McKillop, Stuart, and Geissler (1980) in which quantitative estimates of competition between softwood timber products and their substitutes were obtained for the U.S. in simulation runs by perturbing demand shifters (housing starts, value of non-residential construction, industrial production, and others) and supply shifters (raw material prices, employee wage rates, mill labor productivity, and price of energy). In the Philippines, examples of such models are those of Sibal (1978) which treated 5 products including logs, lumber, plywood, veneer, and fiberboard, and Krittanon (1974) which dealt with a single product, lumber.

An extremely detailed econometric effort was recently undertaken by Nomura and Yukutake (1983). Specific components of the model were also reported by Yukutake (1984). These components are the South Sea and USSR Log Markets in Japan (Japan refers to South Sea sources as Southeast Asia and other Pacific sources). Yukutake's work contained 24 structural equations, which gives an idea of the size of the full model of the Japan forest sector. An important development in the South Sea log market, the growing tendency of the ASEAN producers to restrict log exports in favor of processing, was addressed by Yukutake. His results confirm the strong dependence of Japan on these suppliers for tropical logs by the strong explanatory power of South Sea log price in explaining ordinary plywood price and residential construction activity.

Spatial Models

Spatial models have, in recent years, become the standard of trade flow modeling. Sophistication in methods through the development of procedures to solve complex market interactions made spatial models readily available to economists. Quasi-spatial models achieve a degree of disaggregation of supply sources and/or demand points on a regional basis. However, transportation costs are still ignored and prices are identical in supply and demand equations, as in non-spatial models. An example of this type of model is the work on softwood stumpage, lumber and plywood markets by Adams (1977). This model employs a single aggregate (national) demand relation for each major product and several regional supply equations. Equilibrium is achieved by equating total demand to the sum of supplies from all regional sources.

The true spatial models provide the most comprehensive treatment of trade flows. By design, they are multiregional and functionally describe trade flows between all trading regions. The multimarket, multiproduct problem was first conceptualized by Samuelson (1952), identifying the price equilibrium problem as equivalent to a constrained maximization problem - the objective function being to maximize returns to each source net of the cost of transporting the goods to their destinations. Takayama and Judge (1964) demonstrated this approach in a quadratic programming framework with the objective function of maximizing the sum of producer and consumer surpluses. Recent contributions by Duloy and Norton (1975) and by Buongiorno and Gilless (1983) provided solution procedures for both linear and non-linear systems of supply and demand relationships. Adams and Haynes (1980) cite several early attempts to model the forestry sector in a spatial context, notably a model of inter-regional competition in the U.S. lumber industry by Holland and Judge (1963), a spatial model of the plywood-lumber sector by Holley (1970), and a model of the Southern Appalachian hardwood lumber-using industry by Davis, Lyons, and Burkhart (1972). The most highly acclaimed spatial modeling work, however, is the Timber Assessment Market Model (TAMM) by Adams and Haynes (1980). TAMM analyzes the American plywood, lumber and stumpage markets on an inter-regional basis (8 supply regions and 10 product demand regions) taking into account the vertical linkages between final product and factor markets. TAMM employed reactive programming using an algorithm developed by King and Ho (1972), a revision of the original algorithm developed by Tramel (1965).

The reactive programming solution is an iterative procedure of successive incremental approximations of the equilibrium solution given some initial "guess". The algorithm proceeds by determining of any producing region can obtain a greater profit from the reallocation of supplies to demand regions, given that the levels of output and trade flow patterns remain fixed in all the other supplying regions. When all regions can no longer attain additional profit within some tolerance level, an equilibrium is achieved resulting in a revenue-maximizing and market cost-minimizing solution.

By far, the most ambitious of all spatial modeling efforts in forestry must be the Global Trade Model (GTM) initiated by the International Insititute for Applied Systems Analysis (ILASA). A test version of the GTM has been described by Dykstra (1983). The structure of the GTM is an adaptation of a model of the North American pulp and paper sector proposed more formally for international trade in newsprint by Buongiorno and Gilless (1983). The GTM is conceived as a programming model with linear contraints and non-linear objectives which maximizes the sum of consumer and producer surpluses for all regions and products subject to the usual raw material balances, inter-regional quotas, trade flow "inertia" effects (lagged variation), and other trade restrictions (Dykstra, 1983).

Modeling Tropical Timber Trade: An Overview

Although considerable modeling effort has been devoted to forest products trade in the Western and more developed economies, existing models of timber trade in tropical timber products are limited. The most notable work in this area is a spatial model of log and lumber trade between three African regions and Europe by Adams (1985). The Africa-Europe tropical timber trade model is an offshoot of the TAMM model.

Trade flows were simulated in the context of a competitive equilibrium process through a reactive programming algorithm. Joint equilibrium in the log and sawnwood markets was achieved through successive iterations of partial or trial solutions involving log and product prices in the stumpage and final product sectors. Figure 1 illustrates the solution process leading to a joint equilibrium in both the stumpage and product market sectors. The rest of the world was treated as an exogenous component of Adams´ Africa-Europe model, externalizing the potent influence of the Southeast Asian producers and The Asian entrepots (or "in transit processors") in the European market.

Adams (1982) also comments on data problems associated with any modeling effort on tropical timber trade. Most notable among these difficulties are (1) unreasonably high recovery factors as derived from reported wood use and product output data, (2) the inseparability of tropical and non-tropical components of plywood and veneer trade figures in the FAO Yearbook of Forest Products , the single most important source of time series statistics on world production of roundwood, logs, lumber, panels, pulp and paper products, and (3) the difficulty in separating the tropical component of plywood and lumber production in Europe and Japan.

Literature on Other Aspects of Tropical Hardwood Trade

Despite the dearth of modeling work in tropical hardwoods, a considerable amount of effort has been devoted to describing and exploring the various aspects of the tropical hardwood trade. Most notable among these sources is the World Bank's Commodities and Export Projections Division of the Development Policy Staff.

Dr. Kenji Takeuchi of that office was reponsible for at least two monumental works (Takeuchi, 1974, 1982). The 1974 paper dealt with a detailed description of tropical hardwood trade in the Asia-Pacific Region. The 1982 paper dealt with tropical hardwood processing in developing countries. A third work, the Tropical Hardwood Handbook, (World Bank, 1984) is apparently a compendium of Takeuchi's work embellished with more relevant facts and figures on tropical hardwoods, in general. All of these works are replete with detailed information from a rich array of sources - most of which are inaccessible to the present author. Takeuchi's treatment spans the breadth of the topic - from source to markets, dealing with the social, political, economic and demographic issues relevant to the subject.

S.L. Pringle, former Chief of Policy and Planning Service of the FAO Forestry Department is responsible for at least two popular articles on tropical wood products, both published in Unasylva, FAO's official forestry journal (Pringle, 1976, 1979). The earlier article dealt primarily with the management and utilization of the tropical moist forests (also called tropical rain forests in European literature). The later article focused on trade issues especially as it affects the United States. Although not as comprehensive as the World Bank papers, Pringle's articles are, nevertheless, rich in descriptive details of world trade flow patterns in tropical hardwoods and include an appraisal of the outlook for U.S. imports from tropical sources. Drawing from the results of previous projections made by the USDA and independent estimates of the FAO, Pringle concluded that the "U.S. may be facing declining supplies of hardwood plywood from its major sources", i.e., East Asia, Southeast Asia, and South America.

Modeling the Forest Products Sector in the Philippines

A number of works in the last 10 years were devoted to modeling aspects of the forest products sector in the Philippines. A review of these works is included in a literature survey conducted by Segura-delos Angeles (1981) for purposes of national development planning. Segura-delos Angeles herself published a study on the demand for Philippines timber products (Segura, 1977). In this study, Segura mentions the dearth of current information on exact measures of demand for Philippine timber products abroad and the sluggish pattern of domestic wood use probably brought about by the recessionary domestic and world economy of that period.

Segura employed a logarithmic equation form to estimate the foreign component of demand for Philippine lumber, plywood, and veneer in the period 1960 to 1974. The three (3) foreign demand equations that were estimated are:

Lumber: $\text{Log } D^L = 1.26632 - 0.08916 \log P^L + 0.96178 \log Y_L$

$(R^2 = 0.77)$

Plywood: $\text{Log } D^P = 4.625 - 2.7901 \log P^P + 2.3913 \log Y_P$

$(R^2 = 0.78)$

Veneer: $\text{Log } D^V = 1.2363 - 1.5843 \log P^V + 1.0994 \log Y_V$

$(R^2 = 0.90)$

Where: D^i = quantity of Philippine product i purchased by foreign countries (Lumber - L, Plywood - P, Veneer - V) [in million BF for lumber and plywood; in 10 million SF for veneer]

P^i = price or unit export value (F.O.B.) of product i (US$ per MBF for lumber, US$ per BF for plywood; US$ per MSF for veneer)

Y_i = per capita gross national product of countries importing Philipping product i, in hundred constant 1960 US dollars.

Serious data difficulties made impossible the estimation of valid domestic demand equations for Philippine timber products. To circumvent this shortcoming, Segura made domestic consumption through components of construction expenditures, data of which were available at the National Census and Statistics Office. These pseudo-demand equations had the form:

$$D^i = \frac{\bar{C}\bar{S}_i}{P_i}$$

Where: D^i = local demand for product i

C = local construction expenditures

S_i = percent share of product i in construction expenditures

P_i = domestic real price of product i

By making assumptions about the behavior of construction expenditures and percentage shares, a real-price sensitive demand relationship was still achieved, in lieu of direct demand estimation.

The total demand scenario for Philippine timber products in 2000 A.D. based on the projections of Segura would require 24.8 million cu.m. of wood raw material equivalent, 9.1 million going to domestic consumption and 15.7 million to the export sector. This is almost 4 times the total log output of the Philippines in 1980. Although it is commonly believed that Philippine timber resources are far more depleted than official figures reflect (World Bank, 1984, p. VIII-2); NRMC, 1980, p. 32; Floro, 1978, p. 38; Wyatt-Smith, 1979, p. 16). Segura is optimistic that the Philippines will meet these requirements. Bonita and Revilla (1977) projected that log supplies in the year 2000 A.D. will, in fact, resut in a surplus of 101 million cu.m. spread out over the period 1980-2000 A.D. The projections made by Bonita and Revilla form part of the Scenario 2000 A.D. component of the Development Academy of the Philippines´ Project on Population, Resources, Environment and the Philippine Future (PREPF) of which Segura´s work is another component. These projections may be too optimistic considering a number of factors, such as (1) the recent serious balance-of-payment and World Bank Loan repayment problems that beset the country in 1984 which threaten to accelerate the growth of wood exports and/or lifting of the log export ban; and (2) the slow pace of reforestation compared to the rapid rate of forest denudation (Hyman 1983, p. 518). Revilla himself, in his Ph.D. dissertation at Yale University (Revilla, 1978), admits that the existing second growth forests in the Philippines are inadequately stocked (p. 137). It will require a truly concerted effort by the government to undertake reforestation and rehabilitation of denuded and poorly stocked logged-over forests to realize the projections of Revilla and Bonita.

A more comprehensive econometric work treats the supply and demand for Philippine forest products, a Masters thesis at the University of the Philippines at Los Baños, by Pedro Sibal (1978). Sibal´s work focuses on 5 products including logs, lumber, plywood, veneer, and fiberboard. Domestic and foreign components of supply and demand were estimated through a set of 16 equations employing a two-stage least-squares estimation procedure. Although this work is probably the most intensive econometric investigation ever produced locally, its usefulness as a policy tool is diminished only by the low values of R^2 obtained for the domestic components of supply and demand. These observations confirm difficulties encountered by Segura-delos Angeles (1977) mentioned earlier in this section and the present author's own encounters with the same problem.

The studies of Segura and Sibal typify a group of works on non-spatial models of a limited aspect of the forest products sectors. Krittanon (1974) estimated demand and supply of lumber in the Philippines using an array of price and exogenous variables similar to Sibal's although Krittanon's work came earlier and was limited to lumber only. Ricasio (1976) published his accreditation paper in development economics at the University of the Philippines a year earlier than Segura's work. Although these studies were most possibly initiated and conducted independently, the treated the same subject--long-term prospects of domestic supply and world demand for Philippine forest products. Segura's successful estimation of foreign demand employed per capita GNP of importing countries while Ricasio's estimates involved national income, construction activities, and domestic prices in wood-importing countries.

A more classical approach to the trade issue can be found in works of Floro (1978) and Tumaneng (1982). Floro examines the basic strategy of expanded wood processing in the light of Philippine competitiveness in the export markets. Her Ricardian approach attempted to shed light on whether or not the Philippines enjoyed any comparative advantage in wood processed exports. Apparently, her work was prompted by the existence of "a priori" endorsement for export processing in the Philippines. For example, Takeuchi (1974) successfully demonstrated, using the "value-added" approach, that the best strategy for timber-rich developing economies is to refrain from raw material exports and go for wood processing. Floro's approach involved testing the comparative advantage issue through (1) availability of required factor inputs, (2) productivity and relative factor costs, (3) preference rules and decision framework of investors, (4) factor utilization efficiency, (5) transport costs, and (6) marketing efficiency. She compared capital and labor intensity in 27 industries including the wood industries of the Philippines, Japan, and Korea. Her results contradicted, however, the postulate of the Heckscher-Olin theory--"a country exports those commodities produced with relatively large quantities of the country's relatively abundant factor." According to her results, labor-abundant Korea was exporting its capital intensive wood products, while capital-abundant Japan was exporting its labor-intensive wood commodity. Floro explained away this disparity between practice and theory by the historical entrenchment of Japan in the wood products markets, the import substitution policies of Korea and the Philippines during the period, and the possible occurrence of factor intensity reversals.

Floro also found that Japan, Korea, and Singapore have comparative advantage over the Philippines in terms of labor productivity measured as gross output value per worker. Although the Philippines showed lower production efficiency than either Korea or Taiwan, the comparison across countries may not be entirely valid. Floro accurately identified the differences in log qualities processed by the Philippines and by its log importers. Additionally, Korea and Taiwan effectively utilize processing "wastes" while the Philippines uses these wastes as boiler fuel to generate electricity. Unfortunately, there were no figures to account for all these differences and opportunity costs. In the 1970 structure of transport costs, Floro found that the Philippines was paying higher freight rates than other countries. Floro explains this in terms of the locational pattern of the Philippines' processing plants scattered all over the major islands, close to the wood resource base, in contrast to the centralized loading points in Korea, for example. All in all, Floro's findings tend to show comparative disadvantage against Japan, Korea, Singapore and Taiwan. Without detracting from her impressive examination of comparative advantage in a multi-pronged framework for analysis, it may be mentioned that the industry aggregation of "wood industry" is not reflective of the actual trade patterns existing between these countries. In fact, all these countries mentioned are the Asian entrepots or the "in-transit producers" having historically imported large quantities of logs from the timber-rich ASEAN countries. A disaggregation of "wood industry" into logs and processed products and categorizing these into tropical and non-tropical areas might rectify some inconsistencies in her findings.

Tumaneng's work focuses on government policy on pricing of exports and the structure of production on wood products. She set out to determine the comparative advantage of selected wood firms as measured by domestic resource cost (DRC)--a measure of the social opportunity cost of promoting exports and protecting import substitutes. In formula form:

$$DRC = \frac{\text{total domestic cost in producing the product}}{\text{total value of the output less total foreign cost}}$$

The results of her investigation indicated that logs, lumber, and plywood products were adversely affected by government pricing policies, notably the export taxes and premium duties on lumber in the early seventies. In a comparison among other export-oriented industries, the study showed a clear comparative advantage of the sample firms jointly and separately in their production of logs and wood products. The DRC's were found to be elastic with respect to the border values of output and for most of the sample firms were inelastic with respect to capital service, land, labor, and intermediate inputs. Tumaneng indicated that the wood firms can survive a 40% decrease in the value of total output without losing their competitiveness.

CHAPTER III

METHODOLOGY

This chapter describes the major stages in the development of the policy model, namely: (1) model specification, (2) estimation of model parameters, (3) setting up of the simulation model, (4) validation of estimates against actual baseline data, and (5) application of the model to simulate policy issues. Whenever warranted, a lengthy discussion of problematic aspects of each stage is made as a service to future efforts in this hitherto underexplored field of study.

The model is constructed from basic demand-supply equations for tropical timber products (plywood and sawnwood in the product markets) and logs in the factor markets. Drawing from the observation of Adams (1982), tropical timber product markets may be essentially characterized as competitive owing to the presence of numerous buyers and sellers, the relative ease of entry in the production side of the industry and the relatively free flow of information on prices and market activity in major consuming and most producing regions. Although the products traded are far from homogeneous, they admit of "considerable substitution among grades and regional sources".

The interaction between the product markets and the stumpage markets are accounted for by the model in the same context as TAMM (Adams and Haynes, 1980) and the Africa-Europe tropical sawnwood model of Adams (1982-1984). This linkage is achieved conveniently by converting timber product supplies into log demands using recovery relations which are basically fixed coefficient production functions. In the diagram below, price formation and equilibrium are attained separately in the product and stumpage markets, but the formation of these interactions is dictated by the linkage between product supplies and stumpage demands.

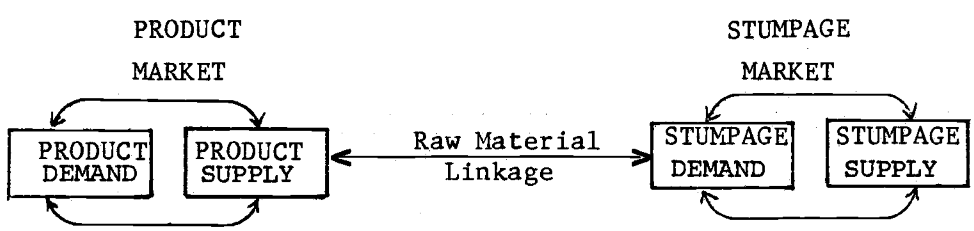


Figure 1. Schematics of Interactions in Timber Product and Stumpage Markets (Curved arrows represent price formation in each market)

From this diagram, it is easy to see how equilibrium quantities in the stumpage market can "dictate" price formation in the product market, and how equilibrium quantities in the product market ripple back to influence price formation and equilibrium quantities in the stumpage market. This multi-market equilibrium process is made possible by the linkage relation of product supply to stumpage demand. Without this linkage, timber products (plywood, sawnwood and veneer) and stumpage (logs) revert to being independent products.

The modeling of tropical trade in timber products (Fig. 2a-2c) in a spatial context is in recognition of the existing trade interactions among the major consuming regions (USA, Japan, Europe) and the major tropical producing regions (Southeast Asia, Africa, Latin America, and the Asian "in transit processors" or entrepots). In the light of the recent atmosphere of regional cooperation in Southeast Asia, it is no longer adequate to examine specific trade policy issues in a non-spatial context (i.e., not considering the interplay of major trade roles). Thus, a policy of restricting log exports from the Philippines must be examined in a model that accounts at least for the economic action of Indonesia and Malaysia. Consequently, a group action calling for simultaneous restrictions of log exports from the ASEAN countries must be viewed in the context of economic implications to Japan and the Asian entrepots because of the latter countries' dependence on the former for tropical log supplies.

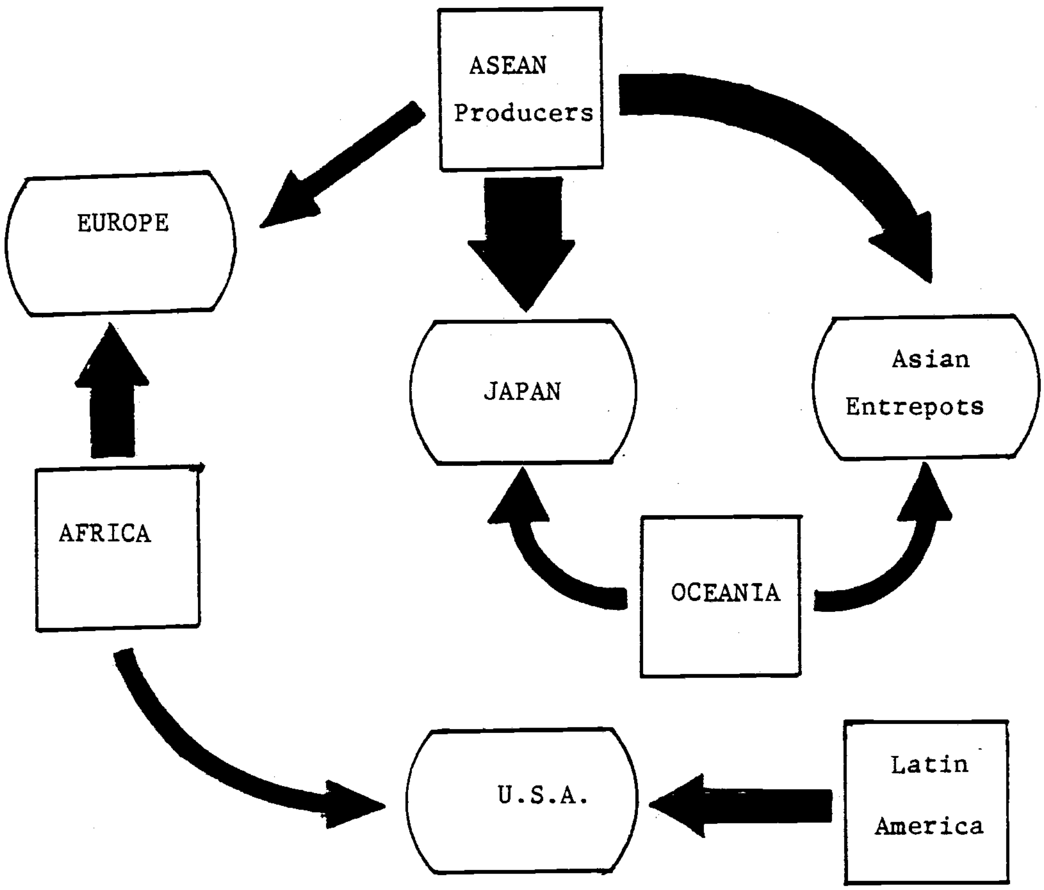


Figure 2a - Major Trade Flows in Tropical Sawlogs
(Arrow size indicates relative volume)

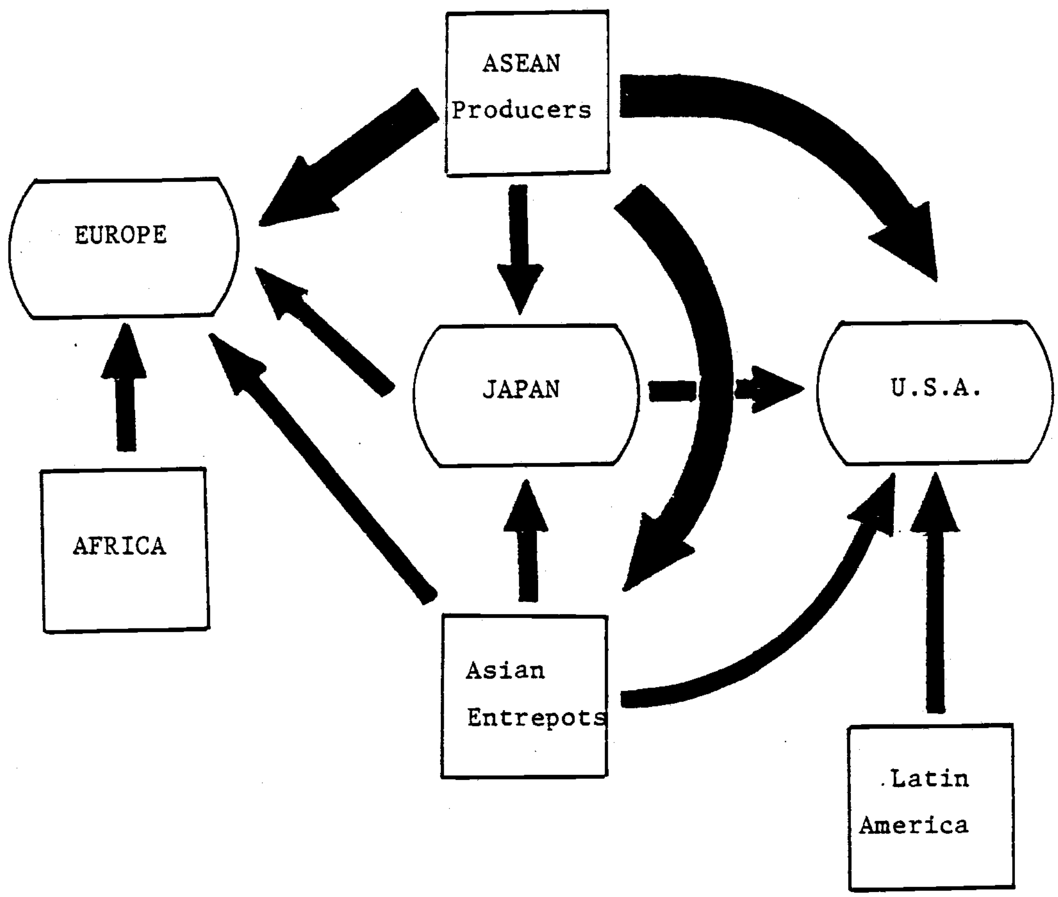


Figure 2b - Major Trade Flows in Tropical Lumber
(Arrow size indicates relative volume)

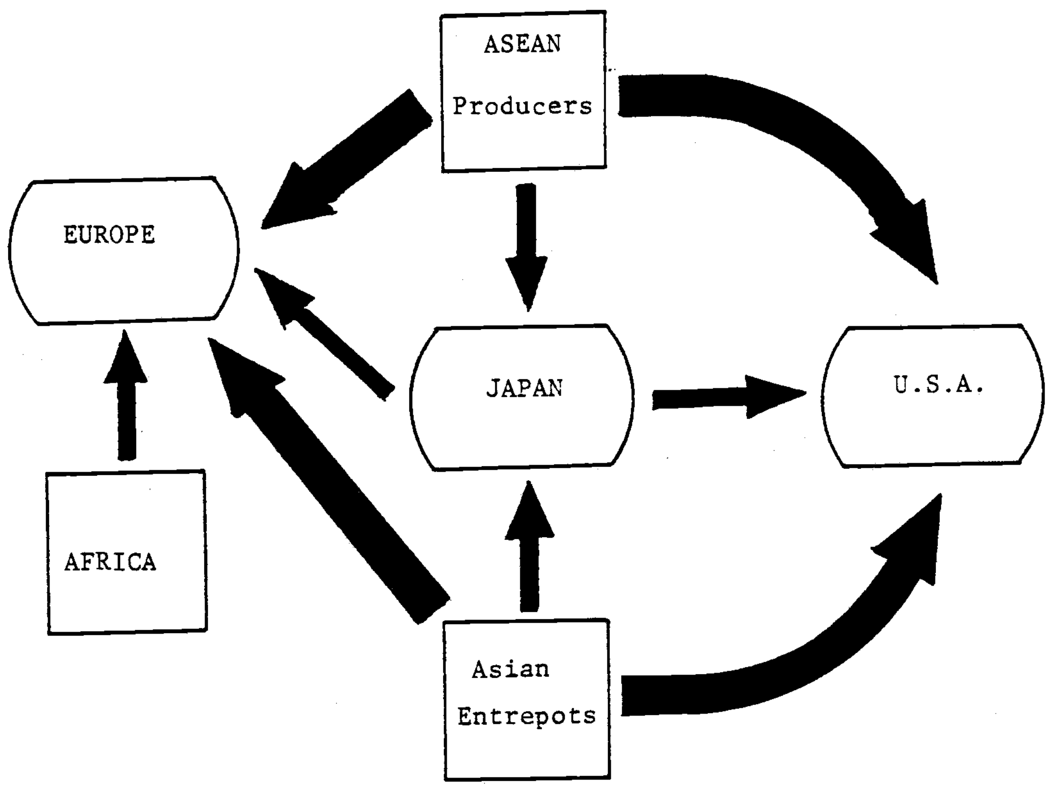


Figure 2c - Major Trade Flows in Tropical Plywood
(Arrow size indicates relative volume)

Although the Philippines has gradually become less and less important as a singular entity in global tropical forest products trade in recent years, its prominent role in ASEAN and ASEAN's critical role in global trade are worth considering. Besides, the intention of the author is to eventually embellish this model enough to be able to examine specific domestic forestry and trade policies for purposes of national planning and development activities.

The Treatment of Products

The original intention of the study was to include the three major timber products: sawnwood, plywood, and veneer. In later stages of the study, it became obvious that veneer cannot be included without seriously jeopardizing the credibility of the data sets. There are several reasons that warrant the exclusion of veneer data from the study and justify its treatment as an "exogenous" item. Firstly, veneer is not as actively traded as either plywood or lumber. Table 1b shows a comparison of volumes of trade and production in veneer in Asia, Africa, and South America. Together, these regions are lumped as predominantly tropical. Total veneer production in these regions is less than 3% of combined sawnwood and plywood volumes. This corresponds to 4.6% for exports and 8.6% for imports. The actual figures for tropical

Table 1b - Production and Trade Figures for Veneer, Plywood, and Sawnwood (Lumber in Predominantly Tropical Regions of the World in 1980. (Volumes in 1000 cubic meters)

	Production	Exports	Imports
A. VENEER (Both Coniferous and Non-Coniferous)			
WORLD	4571	1416	1760
AFRICA	349	195	44
SOUTH AMERICA	357	112	99
ASIA	1263	254	365
PREDOMINANTLY TROPICAL REGIONS	1969	561	508
B. PLYWOOD (Both Coniferous and Non-Coniferous)			
WORLD	39138	6578	5908
AFRICA	451	62	265
SOUTH AMERICA	1118	191	32
ASIA	14288	2683	1196
PREDOMINANTLY TROPICAL REGIONS	15857	3936	1493
C. LUMBER (Non-Coniferous)			
WORLD	111322	12616	12702
AFRICA	5669	687	450
SOUTH AMERICA	12720	1098	727
ASIA	40296	6501	3238
PREDOMINANTLY TROPICAL REGIONS	58685	8286	4415

Source: FAO Yearbook of Forest Products, 1981.

veneer produced and traded are expected to be significantly less.

Secondly, veneer itself is a basic raw material in the production of plywood and a few other types of wood-based panels. It is thus an intermediate product in the conversion of logs, although it is an end product by itself under certain types of uses. In the Philippines, for example, veneer is used extensively as shingle roofing for non-permanent dwellings, as potting medium for seedlings in reforestation nurseries, and as a construction material in cabinetry and wooden novelty products. Being thus an input of one of the products being treated in this study (plywood), the data complications are enormous and cannot be safely rectified within the limits of time and resources available to the study.

Thirdly, veneer (and plywood) statistics do not distinguish between tropical and non-tropical classification. This problem is easier to deal with from the previous one, but the added complication it contributes to the study is not commensurate to its importance in terms of volumes of production and trade relative to sawnwood and plywood.

Spatial Treatment

For purposes of the trade analysis, the spatial treatment of the problem includes demand regions and supply regions separately for the product markets and stumpage markets. The following "regional" classifications were used:

Product Market

Demand Regions	Supply Regions
PHILIPPINES	PHILIPPINES
INDONESIA-MALAYSIA	INDONESIA-MALAYSIA
ASIAN ENTREPOTS	ASIAN ENTREPOTS
JAPAN	JAPAN
EUROPE	EUROPE
AFRICA	AFRICA
USA	OTHER SUPPLIERS
OTHERS	

Stumpage Market

Demand Regions	Supply Regions
PHILIPPINES	PHILIPPINES
INDONESIA-MALAYSIA	INDONESIA-MALAYSIA
ASIAN ENTREPOTS	AFRICA
JAPAN	OTHER SUPPLIERS
AFRICA	
OTHERS	

The exclusion of the South American tropical producers from the model is not arbitrary. Compared to the other regions of the world, South America is relatively self-contained as far as tropical forest products and logs are concerned. In 1980, South America exported only 103,000 cu.m. of logs out of a total of 26,424,000 cu.m. production of non-coniferous logs. The figures for tropical logs should be correspondingly less. This volume of trade is less than 1% of total production.

In the same year, only 8.6% of the 12,720,000 cu.m. of non-coniferous sawnwood produced was exported. The actual figure for tropical sawnwood should be less than 5%. Likewise, South America is not a prominent plywood trader. In 1980, it exported 191,000 cu.m. of plywood representing 17% of its total production. These figures pale in comparison, for example, to Asia's 14,288,000 cu.m. production of plywood and a corresponding export of 3,683,000 cu.m. or 26% of its production. Again, the actual figures for South American tropical plywood production should be considerably less.

Although Africa produces less of all three commodities than South America - logs, sawnwood, and plywood - its proximity to Europe and its very active trade with that continent in tropical logs is a very important aspect of this trade model. The contribution of South America in global trade is lumped under <u>other suppliers</u>. It is certain that

South America in the future will become increasingly more active in global forest products trade. Future modeling efforts will most certainly take this into consideration.

Model Specification

This section presents the theoretical and empirical framework of the policy model and the subsequent solution method employed in generating the simulated environments of alternative trade policies. It may be divided into 3 subsections, namely: (1) demand and supply relations in the product markets, (2) demand and supply relations in the stumpage market, and (3) equilibrium solution method.

Demand and Supply Relations in the Product Markets

Aggregate demand for tropical timber product p in country r may be represented as a function of product prices, substitute prices and national income or some other relevant end-use activity indicator.

$$D^T_{r,p} = D\,(P^T_{r,p},\ \overline{P}^S_{r,p},\ \overline{E}_r) \qquad (1)$$

Where: $D^T_{r,p}$ = apparent consumption of tropical product p in region r

$\overline{E}_r$ = end-use activity indicator in region r

$P^T_{r,p}$ = price of tropical product p in region r

$\overline{P}^S_{r,p}$ = price of substitute products for product p in region r

D ( ) = functional form of the demand equation

The form of D is not constrained to conform to some "a priori" specification model of demand. There is simply not enough information from previous work to adjudge any particular form as most suitable, for the purpose of this study. Initially, however, simple linear relations were stipulated, i.e.,

$$D^T_{r,p} = a_o + a_1\overline{E}_r + a_2P_{r,p} + a_3\overline{P}^S_{r,p} \qquad (2)$$

Where: a_o, a_1, a_2, and a_3 are parameter estimates.

Assuming that like most commodities, timber products are normal goods, economic theory postulates that $a_1, a_3 > 0$ and $a_2 < 0$.

Price variables $P^T_{r,p}$ and $\overline{P}^S_{r,p}$ must be expressed in real terms to hypothesize the absence of "money illusion", i.e., consuming regions behave according to real changes in profit and wealth. A variant of equation (2) used extensively in this study in conjunction with domestic demands of producing regions is the treatment of $\overline{P}^S_{r,p}$ as a price deflator used in conjunction with $P^T_{r,p}$ as follows:

$$D^T_{r,p} = b_o + b_1\overline{E}_r + b_2 \left(\frac{P^T_{r,p}}{\overline{P}^S_{r,p}}\right) \tag{3}$$

Where: $P^T_{r,p}$ is nominal product price preserving the <u>real price</u> hypothesis by the deflationary effect on $\overline{P}^S_{r,p}$. b_o, b_1, and b_2 are parameter estimates and $b_1 > 0$ and $b_2 < 0$. If $\overline{E}_r$ were a monetary variable, then it would be deflated also.

A third form of demand used in this study is the sawnwood demand relation for Europe in the Africa-Europe model of Adams (1983, 1984). It involves a 2-step procedure as follow:

$$\frac{D_{r,p}}{\overline{E}_r} = F_1 \left(\frac{P_{r,p}}{\overline{P}^S_{r,p}}\right) \tag{4}$$

$$\frac{D^T_{r,p}}{D_{r,p}} = F_2 \left(\frac{P^T_{r,p}}{\overline{P}^N_r}\right) \tag{5}$$

Where: $D_{r,p}$ = apparent consumption for (tropical and non-tropical) product p in region r

$P_{r,p}$ = price of product p (combined tropical and non-tropical) in region r

$\bar{P}^N_r$ = average price of non-tropical products in region r

F_1 and F_2 are functional forms and it is postulated that F_1' and F_2' are negative.

Equation (5) models demand for tropical product p as a fractional share of total combined demand for both tropical and non-tropical components of p. A third equation, the identity relation:

$$D^T_{r,p} = \left(\frac{D^T_{r,p}}{D_{r,p}}\right) D_{r,p}$$

is required to express $D^T_{r,p}$ as a function of prices and exogenous variables only.

The modeling of supply of tropical product p proceeds from the basic concept of the marginal cost curve of competitive firms aggregated into an industry-wide supply curve.

In Figure 3a the discontinuous curve S has the functional form:

$$\begin{cases} S = f\ (P) \text{ for all } P \geq P_{min} \\ S = 0 \text{ elsewhere} \end{cases}$$

S is identical to the marginal cost curve above the average variable cost curve and represents the short run supply curve of the competitive firm. Rational economic behavior suggests that the firm can minimally operate down to Q_{min} at market price P_{min} without using any of the rent to the variable factors of production. Obviously, operating below Q_{min} will not only lose all the rent to fixed factors but will also lose part of variable costs, hence it becomes more "profitable" for the industry to shut down at this region of production. The corresponding industry short run supply curve is the horizontal summation of all the individual supply curves of the firms participating in the industry and is shown in Figure 3b as SS.

Logs are the major inputs to the production of plywood and sawnwood and Takeuchi (1983) estimates the share of logs in total production cost of plywood as being between 40-52% for the log-producing regions and as much as 60-71% for Singapore, Japan and other log importers. A log-price and own-price dependent supply function for product p may then be postulated as:

$$S^T_{r,p} = S\ (P^T_{r,p},\ M_{r,p},\ P^L_r,\ \overline{N}_{r,p}) \tag{6}$$

Where: $S^T_{r,p}$ = quantity of p supplied in region r

P^L_r = log price in region r

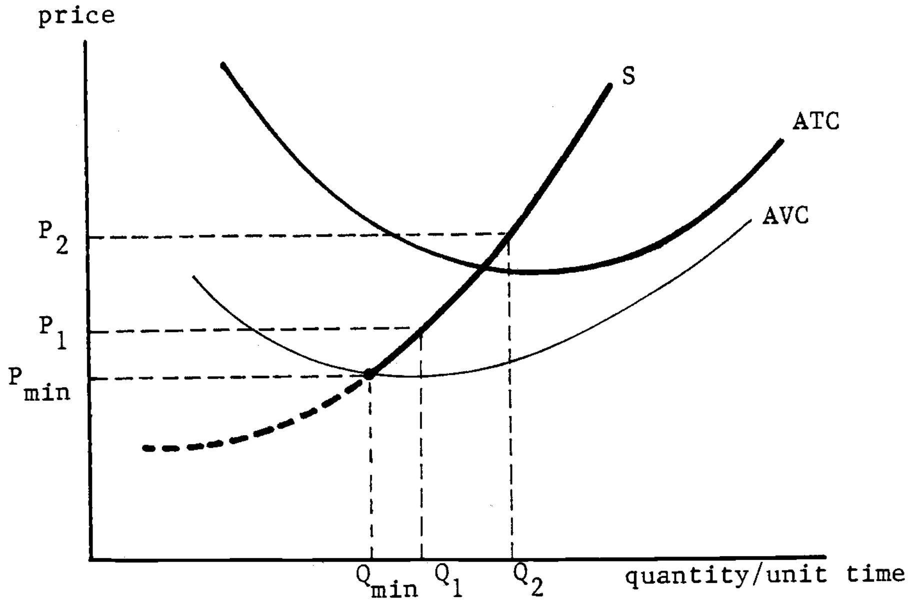


Figure 3a - The Short-Run Supply Curve of the Perfectly Competitive Firm

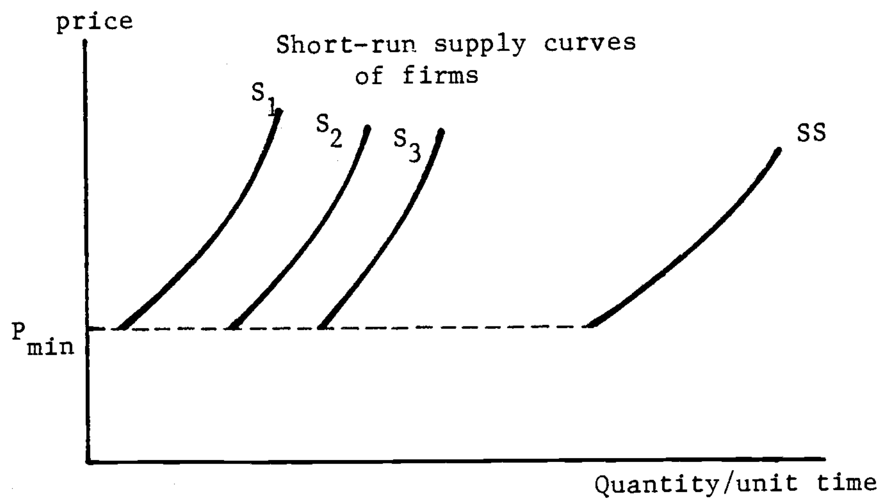


Figure 3b - The Industry Supply Curve SS as a Horizontal Summation of Short-run Supply Curves of Firms.

$M_{r,p}$ = raw material multiplier for product p in region r. This is equivalent to the reciprocal of the recovery rate in converting logs to product p.

$\overline{N}_{r,p}$ = non-wood (or non-log) costs in the production of p in country r.

S ( ) = form of the supply function

As in the case of demand, no "a priori" stipulations of the functional form of the supply relations were made. A naturally simple form is the linear function:

$$S^T_{r,p} = c_0 + c_1 P^T_{r,p} + c_2 (M_{r,p} P^L_r) + c_3 \overline{N}_{r,p} \qquad (7)$$

Where c_0, c_1, c_2 and c_3 are parameters to be estimated. Economic theory indicates that $c_1 > 0$ and $c_2, c_3 < 0$.

<u>Demand and Supply Relation in the Stumpage Market</u>

The demand for stumpage is a <u>derived demand</u>, that is - the quantities demanded are dependent upon the quantities of plywood, sawnwood, and other products that are produced from the conversion of logs. Timber products are believed to possess fixed coefficient production functions and with good reason. Due to the physical make-up of the traditional timber products (sawnwood, plywood, veneer, etc.), wood inputs are non-substitutable inputs and, under any given production technology, the quantity of output of any timber product is directly proportional to the amount of log raw material consumed.

In this context, therefore, log demand is a simple statement of the log raw material requirement for any given level of output of a single product or a product line. Thus:

$$d^T_r = M_{r,s}\, S^T_{r,s} + M_{r,w}\, S^T_{r,w} + M_{r,o}\, S^T_{r,o} \qquad (8)$$

Where: d^T_r = demand for tropical logs in region r

$M_{r,s}$ = raw material multiplier for tropical logs in sawnwood production in region r

$M_{r,w}$ = raw material multiplier for tropical logs in plywood production in region r

$M_{r,o}$ = raw material multiplier for tropical logs in all other products in region r

$S^T_{r,w}$ = production of tropical plywood in region r

$S^T_{r,o}$ = production of other tropical products in region r

$S^T_{r,s}$ = production of tropical sawnwood in region r

It is possible to estimate the derived demand for logs from each product separately, and thus:

$$d^T_{r,p} = M_{r,p} S^T_{r,p}$$

Where $d^T_{r,p}$ = demand for tropical logs in the production of product p in region r

Substituting the basic relation for supply in equation (7),

$$d^T_{r,p} = M_{r,p}(c_o + c_1 P^T_{r,p} + c_2 M_{r,p} P^L_r + c_3\overline{N}_{r,p})$$

or $$d^T_{r,p} = c'_o + c'_1 P^T_{r,p} + c'_2 P^L_{r,p} + c'_3\overline{N}_{r,p} \quad (9)$$

Where: $c'_o = M_{r,p}C_o$

$c'_1 = M_{r,p}C_1$

$c'_2 = M_{r,p}C_2$

$c'_3 = M_{r,p}C_3$

With c'_2 , c'_3 < 0

Equation (9) contains both log and product prices. The product price $P^T_{r,p}$ serves as the forward linkage of the stumpage market to the product market.

Supply of stumpage from tropical sources is not as well behaved as the product sector. While wood processing plants are generally owned by the state, the prevalent practice of stumpage sale is through the leasing-out of large tracts of timberlands to private corporations as franchises or licenses to cut and/or process timber for a fixed duration of time. Adams (1983) observed that government pricing policies in these countries are not necessarily based on actual production costs or revenue from discounted value of yields. In addition, governments tend to adopt conservative policies that act as barriers to the free flow of trade in logs. The log export restrictions in the Philippines starting in 1976 and, more recently, similar policies by Indonesia and East Malaysia are prominent examples. Despite these limitations, the sale of logs per se in the ASEAN log market, for example, is conducted solely by private enterprise and government pricing and other regulations are taken as costs or constraints in the sale.

The production of logs in the context described above may be postulated as:

$$S^L_r = (P^L_r, \overline{AAC}_r, \overline{LC}_r) \qquad (10)$$

Where: s_r^L = supply of tropical logs in region r

p_r^L = price of logs in region r

$\overline{AAC}_r$ = annual allowable (timber) cut in region r

$\overline{LC}_r$ = logging or log production costs in region r including log transfer costs from forest to mill or deck

The annual allowable cut acts as the upper limit to the amount of logs removed from the forest. It is assumed that below this level, a positively sloped log supply schedule is described representing the industry's capacity to produce more logs at increasing prices. At the cutoff point of the $\overline{AAC}$, any price increase will not be matched by a corresponding expansion of output. A reasonable form of equation (10) would then be:

$$s_r^T = d_o + d_1 P_r^L + d_2 \overline{LC}_r; \quad \text{for } s_r^T < \overline{AAC} \tag{11}$$

$$S_r^T = \overline{AAC}, \text{ elsewhere} \tag{12}$$

Where d_o, d_1 and d_2 are parameter estimates with

$d_1 > 0$ and $d_2 < 0$

Equations (11) and (12) together form a typical log supply function for tropical log producing countries - equation (11) represents the price responsive portion AD of the supply curve. Equation (12) is the perfectly inelastic portion, e.g., BC in Figure 4. ABC and AGH represent two log supply curves corresponding to two trial allowable cuts, $\overline{AAC}_1$ and $\overline{AAC}_2$. If market demand for logs were described by DD, then $q_1 = \overline{AAC}_1$ units would be produced in the more conservative schedule ABC at the price P_1 while q_2 units will be produced in the other schedule, ADE, at price P_2. Thus, a more conservative allowable cut policy would result in lower output and higher log prices. Timber supplies necessarily become less accessible as the nearby timber sources are harvested first in the course of logging operations. This has the incurable consequence of increasing <u>logging and hauling costs</u> as labor, supplies, machinery, and products have to be transported over increasingly longer distances (and generally higher elevations) from the mill or logging camp.

Whether or not the resource owner is benefited by the imposition of an allowable cut depends upon the elasticity of the derived demand curve, DD. This boils down to comparing total receipt with the allowable cut $\overline{AAC}_1$ and without the allowable cut.

Without the allowable cut, the industry will operate along AG, the positively sloped portion of the supply curve

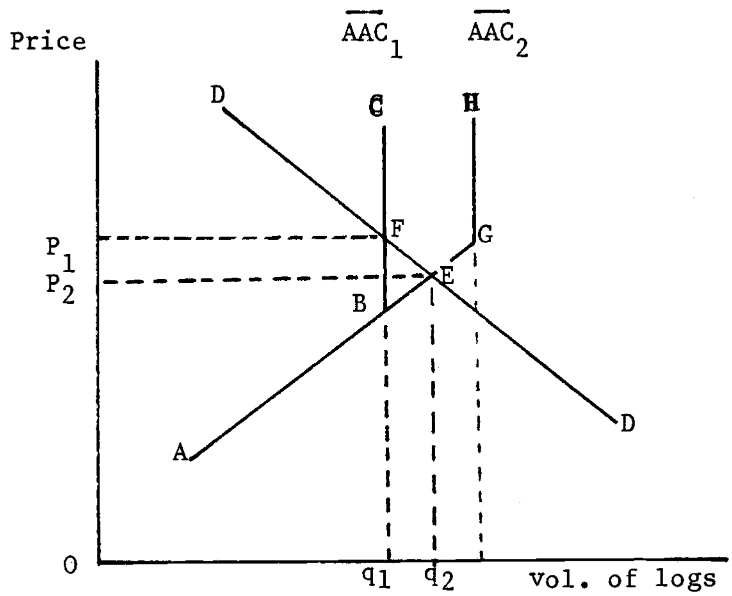


Figure 4 - Log Supply Schedule in the Presence of Allowable Cut Limits

and will produce q_2 units at price P_2. Total receipts to the industry will be P_2q_2 or the area of the rectangle Oq_2EP_2.

With the allowable cut $\overline{AAC}_1$, the industry will produce $q_1 = \overline{AAC}_1$ units at the higher price P_1. Total receipts to the industry would be P_1q_1 or the area of the rectangle Oq_1FP_1.

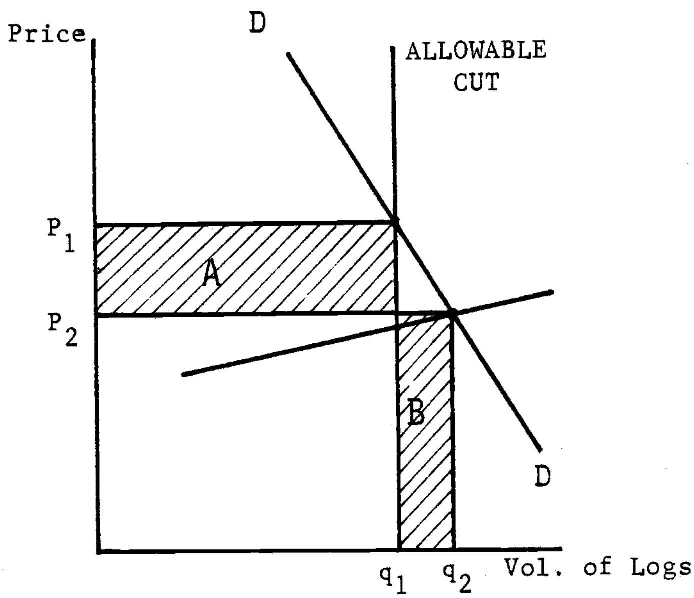
Without going into any formal mathematical derivation, it is easy to visualize that the industry will receive more from an allowable cut imposition if it is facing an inelastic log demand curve, than when log demand was elastic (Figure 5

Panels 1 and 2). In Figure 5, shaded area A represents industry gains due to a policy of moving from a no-allowable cut state to one with an allowable cut restriction . Shaded area B represents industry gains from moving in the opposite direction. To show that a specifc direction of policy results in greater benefits to the industry simply requires the comparison of areas A and B. Thus, an allowable cut policy will be good to the logging industry only if DD is inelastic (Panel 1). Conversely, a relaxation of an allowable cut policy is good to the industry only in the face of an elastic log demand curve (Panel 2).

Equilibrium Solution Method

To take into account the spatial requirements of the model, a solution method for this type of problem must be capable of obtaining both multimarket and multiproduct equilibria solutions in the multi-regional trade boundaries of the problem. Programming requirements of such a solution method would certainly be enormous. Fortunately, one such algorithm, reactive programming, is now readily available with little modification to solve the spatial equilibrium requirements of this problem. The algorithm was first developed by the late Thomas E. Tramel at Mississippi State University in collaboration with A.D. Seale, Jr., and Venner G. Hurt. The first practical application of reactive

Panel 1 - Allowable Cut with Inelastic Log Demand



Panel 2 - Allowable Cut with Elastic Log Demand

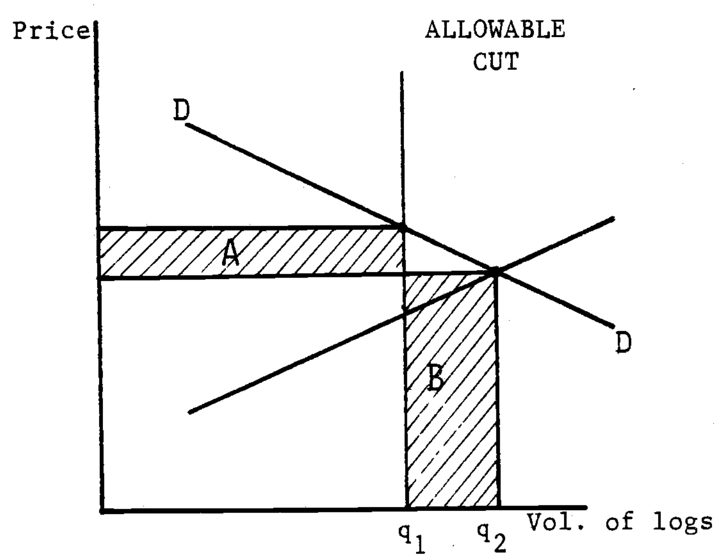


Figure 5 - Elasticity of Log Demand and the Allowable Cut

programming, or REACT, as it has come to be more popularly known in later years, appeared in the Journal of Farm Economics in December 1959. From then on, a number of improvements in several versions have been introduced in the original algorithm. A modified version of REACT was used by Adams and Haynes (1980) in TAMM. A smaller iterative version for microcomputer application was employed by Adams (1983) in his Africa-Europe sawnwood model.

The main difference in the versions used for modeling timber markets and the most current editions of REACT lies in the incorporation of the factor market or stumpage sector in the model. Recent versions of REACT, like King and Ho (1972), King and Rouse (1977) and King and Gunn (1981) address the spatial problem solely in the context of the product markets.

An Overview of REACT

REACT is basically two algorithms in one. Computationally, REACT employs a transportation problem algorithm to produce an initial allocation, then uses another algorithm (reactive programming) to revise this allocation. Transportation problem is a special linear programming problem that allocates supplies from M regions to meet demands in N markets with the objective of minimizing total transfer costs. The transportation algorithm is constrained to allocate fixed supplies to meet fixed demands. The reactive programming algorithm goes beyond this limitation by permitting supply and demand functions to replace the fixed supplies and fixed quantities demanded.

The solution procedure is accomplished in the following manner:

1. Using initial fixed demand and supply quantities provided as input, the transportation problem algorithm allocates these fixed supplies using lowest-cost routes.

2. This allocation is then evaluated and adjusted in order to maximize market prices minus transfer costs for each supplier in turn, while shipments from all other supply points are held fixed.

3. The updated allocations are then resolved by the transportation algorithm, and a new allocation is made and consequently adjusted.

4. When two successive re-allocations yield the same supply and demand quantities and trade flows within some given tolerance, the spatial problem is solved.

A more detailed presentation of the procedure is given as follows: The transportation problem algorithm solves the linear programming problem:

$$\text{Min} \quad TC = \sum_{ij}\sum T_{ij}\, Q_{ij}$$

$$\text{s.t.} \quad \Sigma Q_{ij} \leq S_i$$

$$\Sigma Q_{ij} \geq D_j$$

$$\Sigma Q_{ij} \geq 0$$

Where: TC = total transfer costs

T_{ij} = transfer costs from supply region 1 to demand region j

Q_{ij} = shipments from supply region i to demand region j

S_i = total quantity supplied by supply point i

D_j = total quantity demanded by demand point j

The fixed quantities Q_{ij} in the transportation problems are then replaced by price-dependent functional forms, i.e.,

$$P_j = f_j (\Sigma Q_{ij}), \qquad i = 1,2,\ldots M$$

Where: $\sum_i Q_{ij} = D_j$

and $$C_1 = g_i (\Sigma Q_{ij}) \qquad j = 1,2,\ldots N$$

where: $\sum_j Q_{ij} = S_i$

P_j is the price of the product in region j

C_i is the cost of the product in producing region i

f_i and g_i are functional forms

The net price for quantities supplied from supply region i to demand region j is computed as:

$$r_{ij} = P_j - C_i - T_{ij}$$

The weighted average net price of all shipments from producing region i is:

$$\overline{r_i} = \Sigma r_{ij} Q_{ij} / \Sigma Q_{ij}$$

The reactive programming problem to be solved consists of the M x N equations:

$$r_{ij} = f_j (\Sigma Q_{ij}) - T_{ij}, \; i = 1,\ldots M; \; j = 1,\ldots N$$

s.t. $Q_{ij} \geq 0$ (non-negative shipments)

For active routes: $Q_{ij} \neq 0$ and $r_{ij} = \overline{r_i}$

For unused routes: $Q_{ij} = 0$ and $r_{ij} \leq \overline{r_i} \geq 0$

$Q_{ij} \leq S_i$ (Total shipments received from i may not exceed supply)

The transportation problem algorithm generates the least-cost flows for a given set of fixed initial supplies and demands. The allocation provided is then revised by the <u>reactive programming algorithm</u> by recalculating the level of production in each supply region using the functional forms (if specified) and revising the market totals and trade flows. A reallocation of supplies is then made by taking one supply route at a time. The iterative revision of each supply route is internally done by using Newton´s method:

$$^{k}Q_{ij} = {}^{k-1}Q_{ij} - r_{ij} / (f'_j - C'_i)$$

Where: K is the iteration no.

f'_j and C'_i are the derivatives of the $j^{\underline{th}}$ market demand function and the $i^{\underline{th}}$ supply function, respectively.

When the difference between the average net price $\bar{r}_i$ and the net price for a given route, r_{ij}, is less than or equal to a specified level of accuracy, further reallocation of supplies is no longer profitable to any particular region and so the reallocation problem is solved.

<u>Flexibility of REACT</u>

Multiregional, multiproduct, and multiperiod problems can easily be solved by REACT. A joint solution of the product and stumpage markets is built into the algorithm version used by Adams and Haynes (1980) and Adams (1983, 1984). A two-product case like this study is handled as a single product case by replication of the M supply and N demand points, i.e., there would be 2M and 2N supply and demand regions, respectively. Thus, sawnwood would be represented as the product shipped from i = 1, ...M supply points to j = 1 ...N demand points. <u>Plywood</u> is represented as the product shipped from i = M+1, ...2M supply points to j = N+1, ...2N demand points. It is necessary to have both products expressed in the same units so that the sums of the shipments assume a relevant meaning. In addition, shipments from the sawnwood sector must be blocked from entering the plywood sector and vice-versa. This is done simply by assigning very high transfer costs to these routes. Figure 6 illustrates this procedure more clearly. The shaded rectangles are the lumber to plywood and plywood to lumber routes which are meaningless to the problem, hence they must be blocked-off in the algorithm. Multiperiod problems are solved in the same manner - by blocking the movement of products from one period to another. Conceptually, a multi-market, multiperiod, and multiproduct problem can be modeled simply by correspondingly increasing the dimensions of M and N, and blocking out the meaningless routes.

Limitations of REACT

Because of the unconstrained competitive market structure of the allocation procedure, REACT cannot model "inertia" of trade flows. For example, trade in plywood between the Philippines and the U.S. does not immediately cease because a more profitable route to Europe is opened. Trade ties take time to materialize or completely cease. Likewise, REACT cannot model "cross-hauls" - or the simultaneous shipment of the same product across the same route. In timber trade, this occurrence is rare and it may be rightfully assumed that the

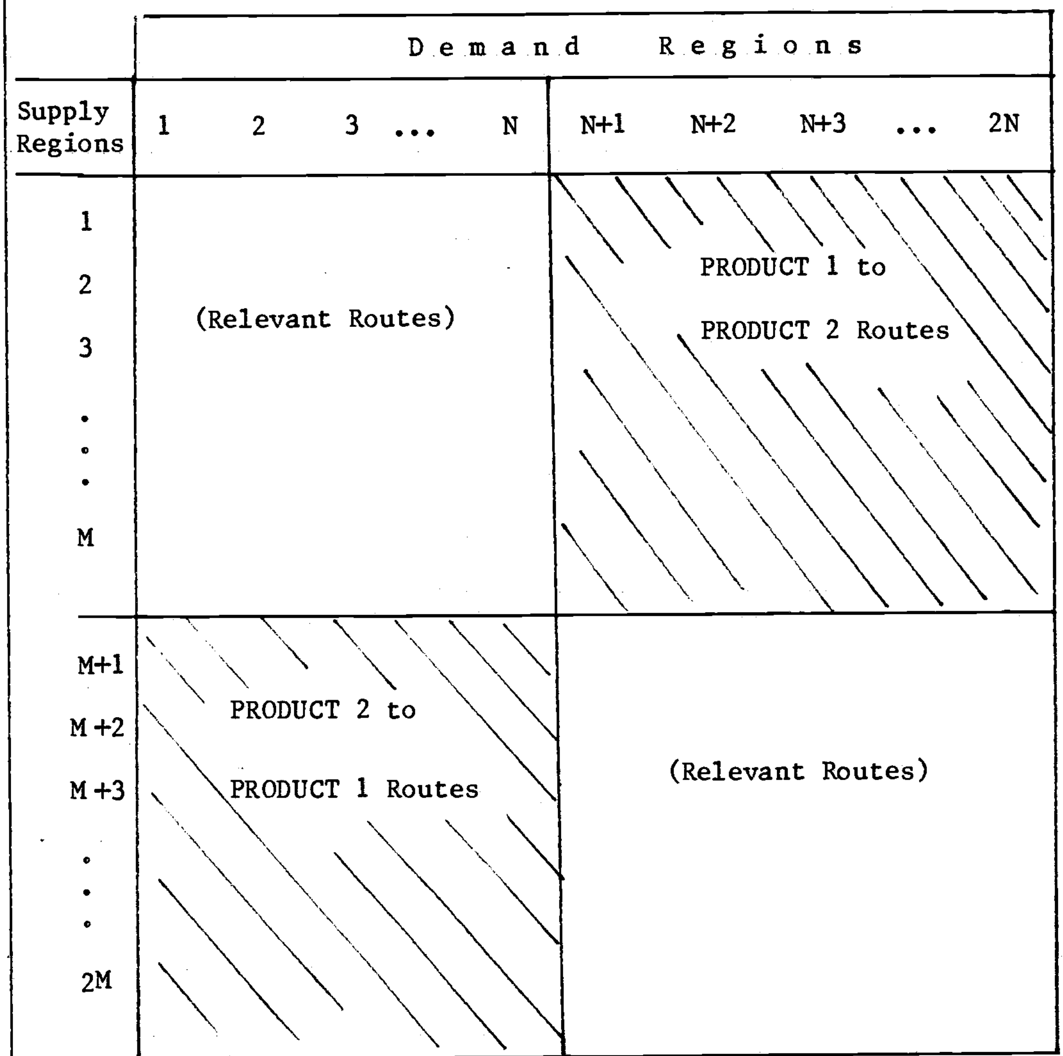


Figure 6 - The 2-Product Problem Configuration in REACT

products being traded this way are usually of a different grade, species, or other specifications.

Estimation of Model Parameters

Estimates of the demand and supply equations for timber products and the supply of logs from tropical producers were derived, generally, by Ordinary Least Squares (OLS). Ordinarily, one would estimate parameters in a simultaneous equation system of the sort developed here by some consistent means such as two or three stage least squares.

Given the exploratory nature of the current research, the limited availability and quality of data, and the generally acknowledged robustness of OLS under specification error (a serious concern in many relations due to lack of data), OLS has been employed. It is recognized that resulting parameter estimates will be potentially biased and inconsistent.

Behavioral assumptions in demand and supply formation were strictly followed in selecting final equation forms. For example, product price coefficients in the demand equations (2), (3), (4), (5) and (9) were required to be negative. The coefficient for substitute price in equation (2) was required to be positive. In like manner, coefficients for product prices in supply equations had to be positive and the corresponding coefficients of factor variables, $\overline{LC}_r$ and P_r^L, had to be negative. All statistical estimation procedures were done using the microcomputer version of Time Series Processor (TSP).

Because of the serial nature of the data, a strong evidence of serial correlation in the disturbance terms is inevitable in many estimates. Such occurrence is usually corrected by an autocorrelation adjustment procedure such as the one developed by Cochrane and Orcutt (Hall and Hall, 1981 p. 31). This method obtains efficient estimates when the disturbance term U_t displays first-order serial correlation, that is:

$$u_t = e_t + rho * u_{t-1}$$

Where: e_t is a constant

rho is the coefficient of serial correlation

This method estimates rho from OLS residuals, transformed variables will be approximately serially uncorrelated, and then runs a regression using the transformed variables. The transformation is:

$$\dot{X}_t = X_t - rho * X_{t-1}$$

Where: $\dot{X}_t$ is the new transformed variable

X_t is the original untransformed variable.

The process is repeated until the rho converges or the preset maximum number of iterations is reached.

Quite frequently the regressions resulting from the corrective procedure were disastrous and unusable. Typical results were changes in signs of the coefficients that carry postulated behavioral assumptions, negating their application to the model. In cases like this, the original estimates were employed rather than the corrected regressions.

Setting Up the Simulation Model

The resulting supply and demand equations developed in Appendix 1 form the core equations of the simulation model. They are used hand in hand with estimates of transport costs from producing regions to consuming regions and initial values of supply and demand to complete the set of primary inputs to the reactive programming algorithm. The secondary inputs are control variables that determine program execution, convergence limits, and information retrieval options. A more thorough explanation of these inputs may be found in King and Gunn (1981, p. 29).

The first procedure in setting up the model is to transform the demand and supply equations into price dependent forms. In the estimation of these equations, the quantity-dependent form was used, i.e.,

$$Q = f\ (P, \bar{E}, \bar{P}, \ldots, Y)$$

Where: Q = quantity supplied/demanded of the product

P = price of the product

$\bar{E}$ = exogeneous end-use activity variable(s)

Y = other endogenous variable(s)

$\bar{P}$ = exogenous price variable(s)

Assigning the actual values of the exogenous variables and other endogenous variables results in the simple price-quantity equation, $Q = f(P)$. For the purpose of REACT, the inverse form $P = f^{-1}(Q)$ is required.

Next, the transport cost matrix must be set up. This task involves the assignment of extremely high values to routes that are restricted both as a policy to be simulated, or as it occurs in reality. This technique compels the algorithm to ignore these routes.

In addition, the setting up on the problem as a two-product problem, i.e., it is set up in such a way that product sources for both plywood and lumber are assumed independent (e.g., the Philippines supplying both lumber and plywood are assumed to be two separate supplying regions), requires that the meaningless routes (e.g., Philippine plywood supply region to, say, Japan lumber demand region) are properly blocked out. If there are m actual supply regions and n actual demand regions, then if Q_{ij} were the quantities supplied from region i to demand region j, there would be, in the context of the simulation set up, 2m supply regions and 2n demand regions, with $Q_{1,1}$ to $Q_{m,n}$ and $Q_{m+1,\ n+1}$ to $Q_{2m,\ 2n}$ as the only legitimate routes.

Tariff impositions can be simulated simply by adding to the transport cost for designated routes the approximate value of the tariff. This approximate value can be calculated from actual prices reflected in the data or from equilibrium prices obtained from previous trial runs of the simulation.

The third major items to be set up are the initial supply and demand quantities which must be equal, and the maximum quantities to be produced from each of the supply regions. Production restrictions can be effectively simulated as policy options by correspondingly restricting this particular input value.

Validation of Estimates

The predictive ability of the consolidated set of supply and demand functions that constitute the model must first be demonstrated in the actual data. This is a must before the model may even be considered capable of simulating any short-run trade policy. To this end, the model's predictive capacity was validated against actual 1980 data. This procedure involves unrestricted or policy-free simulation runs and the results compared against the 1980 "baseline" data.

Whenever the simulation results substantially differed from the actual data, a re-examination of the model is made in order to identify the source of variation. A course of action is then plotted to institute corrective procedures which may involve among other things:

(a) A re-estimation of appropriate demand or supply equations;

(b) Modifying assumptions regarding weak components of the model, (e.g., Europe tropical plywood supply and Japan tropical lumber demand) in order to come up with more valid assumptions;

(c) Double checking the basic data for possible errors; and

(d) Modifying assumptions on transfer costs where such costs cannot be accurately obtained.

This fine-tuning process is repeated until simulation results compare satisfactorily with the baseline data. Policy alternatives are then prepared for the simulation runs to follow.

Policy Simulation

To undertake the four-point objective of policy simulations in Chapter I, a total of 12 simulation runs were completed. In the following tabulation, the policy issues on the left are implemented by specific policy simulations on the right. A thirteenth simulation was conducted corresponding to a policy of doubling Philippine processing capability with the rather hard-to-fulfill assumption that such capacity change can be done immediately. Because of its interesting impact on trade in the ASEAN region, this simulation was included for discussion in the next chapter as an addendum policy issue.

Table 2 - List of Policy Simulation Runs

Policy Issue	Implementing Simulations
A. Impacts of log export restrictions	1. Philippine unilateral log export embargo. Indonesia and Malaysia hold their exports at 1980 levels.
	2. The ASEAN Hardwood Cartel (Philippines-Malaysia-Indonesia) totally bans log exports.
	3. Liberalized log export policy with the allowable cut pegged at 8.0 million cu.m.
	4. Same as policy No. 3, but allowable cut is 10 million cu.m.
B. Tariff alternatives to quantitative restrictions on log exports	5. Imposition of an additional 5% export tax on Philippine products.
	6. Lifting of the current 4% export tax on Philippine products with the allowable cut pegged at 6.45 million cu.m.
	7. Same as policy No. 6, but with the allowable cut pegged at 7.45 million cu.m.

(Table 2 cont.)

Policy Issue (cont.)	Implementing Simulations (cont.)
	8. Same as policy No. 6, but with a total log export ban.
C. Trade liberalization in ASEAN	9. Trade between the ASEAN producers is permitted but Philippine allowable cut is pegged at 6.45 million cu.m.
	10. Same as policy No. 9, but the allowable cut is 8.0 million cu.m.
D. Exchange rate effect	11. Philippine exchange rate plunges from US$9.69:₱1 to US$17:₱1 with allowable cut pegged at 1980 levels (6.45 million cu.m.)
	12. Same as policy No. 11, with allowable cut at 8.0 million cu.m.
E. Addendum simulation	13. Effect of doubling production capacities in the Philippines.

CHAPTER IV

RESULTS AND DISCUSSION OF POLICY SIMULATIONS

The absence of global data on supply-side shifters (e.g., labor productivity, technology, plant capacity, stumpage inventory, etc.) drastically limited the application of the current model to non-dynamic short run policy options. It would be desirable to provide an outlook scenario of trade and resources for a particular region, say, in the year 2000 A.D., as a direct application of the model. But despite this limitation, there are still a number of interesting short-run policies the model can readily simulate. These policy issues are extremely relevant to the Philippines in particular and to ASEAN in general.

The detailed listing of these policy simulations is presented in Table 2 in Chapter III.

A summary description of the 4 general policy issues involved is given below:

1. How would a log export embargo unilaterally adopted by the Philippines affect the hardwood forest products and log situation? How about a total ASEAN log export embargo?

2. How will Philippine products fare in the competitive world market setting if the Philippines imposed an additional 5% export tax (as a revenue generating measure)? How

about if it removed the current 4% tax on forest products exports?

3. Recognizing the current atmosphere of regional cooperation in ASEAN, would liberalization of trade in forest products among the ASEAN producers result in a better economic picture for these countries?

4. In the face of a weakening economy such as that of the Philippines (in 1984 it devalued its currency from 9.69 pesos per US dollar to 17 pesos per US dollar), what would such a foreign exchange situation spell for the country in particular and for ASEAN in general? What is the likely picture if this situation were cast in a scenario wherein log exportation by the Philippines is liberalized?

An addendum issue is included here for its hypothetical value:

5. What does it spell for the Philippines and ASEAN if Philippine wood processing were doubled, assuming that such a capacity change can take effect immediately?

It is quite amazing how many of these types of short-run simulations can be actually undertaken by the model in its current form. For example, an alternative scenario of Japanese retaliatory measures aimed at blocking the entry of ASEAN products into Japan in response to an ASEAN log export embargo can be easily simulated by the model.

Baseline Simulation Results

For the most part, fine-tuning the baseline simulation for 1980 involved a great deal of time and effort. Many of the original estimating equations had to be re-estimated (see

Appendices 1 and 2 for the final list of equations and definitions of variables). In a few cases, such as the lumber supply function for Japan, and the plywood supply function for Europe (Appendix 1c No. 4 and 1d No. 5, respectively), ever bolder assumptions of the form had to be made in the absence of anything more usable than can be afforded by the existing data. Difficulties in this respect are compounded by the fact that supply equations provide the linkage to the stumpage sector - via the derived demand for sawlogs. Any changes in the product supply equations, therefore, ripple back and forth through the product and factor markets. In the actual simulation, this effect is observed throughout the two system of trading regions, affecting the final allocation of shipments of both products and logs.

Except for the price of tropical sawnwood in Japan and the African demand and supply of sawnwood, the tropical sawnwood baseline simulation predicts much better than the plywood sector. This is understandable because there being no official statistics on the classification of plywood (into tropical and non-tropical types), a certain amount of guesswork had to be employed especially when dealing with the major (non-tropical) importing regions such as Japan, Europe, and USA. FAO and UN/ECE publish a limited amount of "directions of trade" data on forest products. This and the assumption that products from tropical countries are essentially of the tropical type have made possible the estimation of production and consumption of tropical hardwood products and logs.

Supply estimates in the stumpage sector are particularly weak. Philippine production figures, for example, are negatively correlated to export price - reflecting that country's history of log export restrictions since 1976. This modeling effort, in general, brought to fore the enormous estimation problems to be encountered in any task involving global trade modeling of forest products. The commitment of an equally great amount of personnel, time, and dedication is necessary to insure the success of any such attempt in the future.

Table 3 shows a comparison of the actual and predicted values for the 1980 base year simulation. Based on total volumes predicted, the model underestimates the actual values for 1980 by 11.7% in sawnwood demand, sawnwood supply by 16.4% and sawnwood prices by 11.33%. Unfortunately, Japan's tropical sawnwood price is abnormally high for 1980, suggesting that it probably reflects a greater weight towards specialty or high-grade lumber (notice that its price is greater than plywood). It may be recalled at the beginning of this section that the estimation of Japan's sawnwood supply function presented particular difficulties. The African tropical sawnwood demand and supply figures particularly bloated the average percentage prediction errors. If the

Table 3 - Base Run 1980 Simulation Results
(Comparison of Actual and Predicted Values)

A. TROPICAL SAWNWOOD

REGION	DEMAND Actual	DEMAND Predicted	SUPPLY Actual	SUPPLY Predicted	PRICE Actual	PRICE Predicted
PHILS	1208	1112	1262	1112	244	264
IND-MAL	4412	4662	8647	8117	193	198
ENTREP	1612	1480	1555	1163	226	217
JAPAN	7523	6737	5487	5291	361	260
EUROPE	6044	6020	2733	3227	389	376
AFRICA	4550	2434	5118	2821	201	266
USA	500	388	NA	NA	256	253

B. TROPICAL HW PLYWOOD

REGION	DEMAND Actual	DEMAND Predicted	SUPPLY Actual	SUPPLY Predicted	PRICE Actual	PRICE Predicted
PHILS	723	621	1153	795	336	285
IND-MAL	481	423	1114	543	265	278
ENTREP	991	997	1482	1283	358	286
JAPAN	7450	7239	7200	7239	291	326
EUROPE	982	1287	861	1286	465	379
AFRICA	361	236	451	237	422	560
USA	1354	1242	NA	NA	394	355

C. TROPICAL LOGS

REGION	DEMAND Actual	DEMAND Predicted	SUPPLY Actual	SUPPLY Predicted	PRICE Actual	PRICE Predicted
PHILS	5066	3935	6450	6450	89	84
IND-MAL	23171	15577	43746	42096	89	85
ENTREP	4641	4439	NA	NA	114	100
JAPAN	22906	22928	NA	NA	124	100
EUROPE	5750	7926	NA	NA	141	131
AFRICA	12341	5871	19861	13606	124	59

Demand and Supply values are in 1000 cu.m. and prices are in $ per cu.m.

disparity in the African estimates were ignored, the average predicted demand error on a per region basis will be 9.12% and on a total volume basis, 4.23%. For supply, this error would be 12.9% on a per region basis, and on a total volume basis, 3.93%.

For tropical plywood, average prediction error based on total volume of demand is 2.4%, and for supply, 8.56%. The supply estimate for Malaysia-Indonesia is quite low because of the sudden supply shifts in Indonesia's plywood production as a result of that country's crash efforts to restrict log exports and promote plywood production starting gradually in 1978 and progressing in big jumps into 1980.

In the stumpage sector, Philippine and Indo-Malaysian demand estimates for logs are far short of the actual figures of sawlog consumption. This is expected since the estimated demand values are derived directly from the raw material equivalents of product conversions. The actual log consumption figures, at least as far as the ASEAN countries are concerned, include other conversions like fiberboard, plyboard, and other wood-based panels, and even pulp.

Obviously, a lot of room for improvement may be found in the product supply and stumpage demand sectors. With the product supply equations having only product and log prices as regressors, the supply estimation procedure obviously suffers from problems of specification. To truly reflect the "horizontal summation" of short-run supply (marginal cost) curves, the supply function must include non-wood cost with account for 48-60% of total production cost for plywood. The same kind of problem arises in the log supply equations. A well-specified log supply function must include logging and log-to-mill costs as well as existing stumpage inventory. Unfortunately, such data are generally unavailable even in the more industrialized countries or regions of the world.

Price Elasticities of Supply and Demand

Table 4 shows period-average price elasticities of supply and demand for tropical lumber and plywood in the various regions of the world. These figures imply that sawnwood (lumber) and plywood demand in the Southeast Asian producers are inelastic. This is quite expected because these countries practically produce only tropical timber, they are self-sufficient, and import negligible amounts of timber products. These conditions insure the absence from the market of substitutable materials, e.g., coniferous lumber and plywood. Regions that use less tropical products relative to their total consumption of timber products demonstrated moderate price elasticity of demand (USA, Europe, and the Asian entrepots). This is only logical because in these consuming regions,coniferous or non-tropical timber products are readily available and substitutable for tropical products. Japan

Table 4 - Period Average Price Elasticities
(LUMBER AND PLYWOOD)

REGION	Demand		Supply			
	Lumber to Lumber Price	Plywood to Plywood Price	Lumber to Lumber Price	Plywood to Plywood Price	Lumber to Log Price	Plywood to Log Price
PHILIPPINES	-0.0315	-0.5490	0.3433	0.9574	-0.1441	-0.2823
INDONESIA-MALAYSIA	-0.4903	-0.4328	0.2439	1.2706	-0.1062	-0.1862
ASEAN ENTREPOTS	-1.0531	-1.2021	1.1206	1.2856	-0.1109	-0.4881
JAPAN	-0.1393	-0.3516	1.0212	2.5500	-0.9680	-0.3947
USA	-2.0843	-1.8455	-	-	-	-
EUROPE	-1.57	-1.4004	0.6900	5.3200	-0.4000	-1.6277
AFRICA	-1.1676	-0.7495	0.6296	0.5884	-0.2305	-0.1195

demonstrates inelastic lumber and plywood demand. This is probably due to that country's cultural preference for non-coniferous materials especially in panel products, or an induced-preference for such materials because of the massive importation and utlization of tropical logs in the manufacture of such products in Japan.

In general, the ASEAN countries' supply equations for lumber and plywood are inelastic and moderately inelastic to elastic, respectively. One possible reason for the inelastic lumber supply equations, is the implied requirement of self-sufficiency which tends to force inelasticity. In the case of plywood, these countries are currently going through supply-shifts as a result of new-found markets (Europe and USA). Besides, the use of plywood in their domestic economies allows for substitution with lumber and other indigenous panelling materials.

Tropical logs being the major input in the manufacture of products, the price elasticity of plywood supply with respect to log prices tends to be inelastic in all cases with the possible exception of European tropical plywood production. The immediate reason for this occurrence is not evident but it is possible that Europe can readily substitute non-tropical hardwood logs for African sawlogs in the production of hardwood plywood.

Competitive Advantage of the Philippines Over Indo-Malaysia in Production

There are very few known figures that reflect cost advantages of one region over another. In the case of the Southeast Asian producers, however, there are indicative figures provided by Takeuchi (1982). Based on information provided by industry sources, wages in the plywood industry as of 1980 reveal that the Philippines does indeed show advantage in labor costs. For unskilled labor, the Philippines pays $47/man-month, while Indonesia pays $16-60 per man/month, and Malaysia $102-114/man-month. For semi-skilled labor, the Philippines pays $68/man-month against $24-72 and $155 per man-month in Indonesia and Malaysia, respectively. For skilled labor, it is $100/man-month in the Philippines against $40-175 and $273 per man-month for Indonesia and Malaysia respectively.

Takeuchi further computes that the implied log prices paid by plywood producers in the Philippines are $50/cu.m. in the Philippines, $80 for Indonesia, and $45-66 for Malaysia. These data are the basis for the author's claim that the Philippines enjoys some competitive advantages over its neighbors Indonesia and Malaysia. As would recur quite frequently later on during the subsequent simulations, the Philippines will displace Indo-Malaysia in products as well as in logs, if and when a particular policy results in trade offs between the ASEAN producers.

Results of Policy Simulations

The following sections discuss in detail the results of the individual policy simulations listed in Table 2. All these simulations are set in terms of 1980 trade performance of the major role-players. The first basic assumption in each one of these simulations, therefore, is an allusion to the existence of a policy environment under 1980 conditions. The method of presenting the results of individual simulations will thus be in relative terms to the 1980 base year simulation. Changes arising from the "implementation" of a policy shall be presented in percentage values of the base year.

The Log Export Policy of the Philippines: A Background

As earlier mentioned in Chapter I, the Philippines adopted quantitative restrictions in its log exports starting in 1976. Although such a policy was already being mulled over by the government as early as the sixties, it was not until the passage of the Revised Forestry Code of the Philippines (Presidential Decree No. 705 dated May 19, 1975) that the log export was explicitly mandated by law (Section 32 of that decree states that "the entire production of logs by all licensees shall, beginning January 1, 1976, be processed locally"). This provision was amended in 1976 by Presidential Decree 865 which allowed log exports up to 25% of the allowable cut on a conditional basis. This amendment was apparently spurred by the depressed timber products market during the worldwide recession of 1974-1975.

Rationalization of the log export restriction policy included the following arguments: (1) establishment and growth of wood processing industries; (2) phasing out of uneconomic-sized plants; (3) attraction of capital investments from abroad for joint wood processing ventures; (4) acceleration of reforestation programs; (5) promoting the establishment of industrial tree plantations; and, (6) curbing the alarming rate of forest destruction in the country. The exact mechanisms that would bring about such sweeping changes in the economy, particularly in the forestry sector, were not provided, however. These arguments or "expectations", nevertheless, served as strong rallying points to support the log export restriction policy, no matter how vague the economic justifications were at the time. From the high-sounding words of the ban's rationalization, the expected gains appear to be premised upon the following assumptions:

1. That there was a preponderance of log producers primarily engaged in the export of logs. The log export ban would force these producers to establish processing plants (therefore employ more people and gain more

from value-added), or to drop out of the business entirely.

2. That those producers that decide to stay in the business will easily find business partners from outside the country; or find sufficient local financial sources to readily expand operations.

3. That the resulting immediate expansion of the timber products industry will increase the demand for stumpage and therefore cause a rippling effect in the stumpage sector.

These assumptions are certainly valid if all the component requisites of rapid industrialization are met. However, to realize the magnitude of the change the log export ban is expected to bring to the economy, equally drastic changes in the financial and resource management sectors' policies must take place. Lucrative investment incentives must be provided, and the forestry services must be reoriented towards these drastic changes. No serious preparatory moves were outlined or implemented by the government sector prior to the enactment of the ban to insure the smooth transition towards the expected massive industrialization to follow. The only incentives available at the time were provided by the investment Incentives Act and Export Incentives Act which were by default available to the wood processing sectors with or without the log export ban.

The prevailing notion at the time seems to be that the relative abundance of timber resources was a guarantee for industrialization to succeed. Armas (1976) pointed out that this situation is not sufficient to guarantee comparative advantage in the products sector.

Five years after the implementation of the ban in 1976, the record shows some interesting insights (Refer to Tables 5a and 5b):

1. The average difference between log exports for the post-restriction period 1976-1981 and the pre-restriction period 1970-1975 amounts to a net annual decrease of 5.3 million cubic meters. For the same periods, Malaysia increased its log exports by 4.3 million cu.m. and Indonesia by 2.4 million cu.m. which (allowing for normal growth in their log export sectors) makes up for the unilateral reduction of Philippine log exports. These figures simply mean that the shortfall in the region's log trade was readily filled by the Philippines' ASEAN competitors. At average 1976-1981 log prices in the log export market, this represents an average annual loss of US$473 million in foreign exchange earnings for the country.

2. During the same periods, lumber exports of the Philippines increased from an annual 269,000 cu.m. to 621,000 cu.m. (period averages). Plywood exports increased from 262,000 cu.m. annually in 1970-1975 to 363,000 cu.m. annually in 1976-1981. The increase in lumber exports represents an annual average increase of US$95 million in

Table 5a - Volume of Forest Products Exports and Production: A Comparative Analysis (For Philippines, Malaysia and Indonesia: 1970-1981) Volume Units in thousand cu.m.

		PHILIPPINES		MALAYSIA		INDONESIA	
LUMBER		EXPORT	PRDN	EXPORT	PRDN	EXPORT	PRDN
AVG	64-69	133	1095	891	2163	12	1731
AVG	70-75	269	1240	1726	3680	206	1764
	1976	493	1609	3019	5217	649	3000
	1977	455	1567	2910	5589	594	3500
	1978	573	1781	2787	5147	756	3500
	1979	915	1262	3418	5147	1283	3400
	1980	742	1529	3141	5147	1203	3400
	1981	547	1219	2800	5147	1112	3400
AVG	76-81	621	1495	3013	5232	933	3367
PLYWOOD							
AVG	64-69	181	240	41	77	0	4
AVG	70-75	262	572	235	308	0	26
	1976	260	416	407	525	13	107
	1977	340	489	344	565	14	214
	1978	383	490	410	465	85	279
	1979	417	515	466	490	195	424
	1980	367	553	474	490	245	624
	1981	408	457	469	490	535	1014
AVG	76-81	363	487	428	504	181	444
VENEER							
AVG	64-69	117	177	19	38	-	-
AVG	70-75	155	221	162	171	-	-
	1976	50	403	170	170	-	-
	1977	36	496	208	208	-	-
	1978	31	546	185	185	-	-
	1979	50	634	124	187	-	-
	1980	63	600	127	187	-	-
	1981	39	553	134	187	-	-
AVG	76-81	45	539	158	187	-	-
LOGS							
AVG	64-69	7509	10199	8339	13222	855	4975
AVG	70-75	6993	9251	11656	21166	13319	17818
	1976	2331	8646	15493	26559	17695	23300
	1977	2047	7873	16099	27619	18560	26080
	1978	2200	7169	16708	31469	19200	25000
	1979	1248	6578	16488	31469	17800	21200
	1980	1154	6212	15146	31469	14884	21700
	1981	1437	5280	15854	31469	6221	13300
AVG	76-81	1736	6960	15965	30009	15727	21763

Table 5b - Value of Forest Products Exports: A Comparative Analysis (For Philippines, Malaysia and Indonesia:1970-1981)
(Export Value in Thousand US$)
(Export Volume in Thousand cu.m.)

		PHILIPPINES		MALAYSIA		INDONESIA	
LUMBER		EXPORT	VAL	EXPORT	VAL	EXPORT	VAL
AVG	64-69	133	8367	891	36963	12	552
AVG	70-75	269	20956	1726	130313	206	9975
	1976	493	68034	3019	344166	649	48675
	1977	455	66430	2910	337560	594	49896
	1978	573	84804	2787	345588	756	85428
	1979	915	197640	3418	591314	1283	234789
	1980	742	181048	3141	581085	1203	257442
	1981	547	125263	2800	431200	1112	190152
AVG	76-81	621	115992	3013	434804	933	130597
PLYWOOD							
AVG	64-69	181	20385	41	4640	0	0
AVG	70-75	262	32619	235	35969	0	3
	1976	260	43160	407	74888	13	871
	1977	340	56100	344	66736	14	2408
	1978	383	74685	410	84460	85	19635
	1979	417	113007	466	133276	195	31785
	1980	367	117073	474	135090	245	55615
	1981	408	121584	469	133196	535	119840
AVG	76-81	363	85429	428	102729	281	32731
VENEER							
AVG	64-69	117	8814	19	1406	-	-
AVG	70-75	155	12581	162	6245	-	-
	1976	50	5150	170	8840	-	-
	1977	36	4680	208	11648	-	-
	1978	31	4526	185	8880	-	-
	1979	50	9550	124	15376	-	-
	1980	63	15372	127	16256	-	-
	1981	39	9789	134	21708	-	-
AVG	76-81	45	7958	158	15010	-	-
LOGS							
AVG	64-69	7509	162688	8339	126467	855	11398
AVG	70-75	6993	228422	11656	285574	13319	321880
	1976	2331	135198	15493	573241	17695	778580
	1977	2047	133055	16099	611762	18560	853760
	1978	2200	143000	16708	718444	19200	883200
	1979	1248	143520	16488	1368504	17800	1495200
	1980	1154	148866	15146	1196534	14884	1473516
	1981	1437	155196	15854	1062218	6221	615879
AVG	76-81	1736	156255	15965	923290	15727	1095624

foreign exchange receipts, while the plywood exports represented US$53 million additionally. Together, they account for US$148 million in increased export earning per year. However, veneer exports declined from 155,000 cu.m. to 45,000 cu.m. representing an annual average decrease of US$4.6 million, making the net increase in foreign exchange receipts from the products sector in the amount of US$141.6 million. Thus, solely on the basis of foreign exchange earnings, the Philippines forfeited US$330 million of annual receipts by implementing the log export restrictions in 1976. This deficit is quite close to the prediction made by Armas (1976). Using the usual assumptions of constant technology and export prices, he calculated the opportunity cost (in terms of foreign exchange foregone) of a total log export ban to be around US$240 million per year. Contrary to Armas' prediction, however, lumber exports increased and veneer exports decreased, but his conclusion that the resulting export picture (even with the maximum utilization of existing plant capacities) could not possibly offset the losses brought about by the log export ban, was essentially accurate. What could not have been foreseen by Armas or anyone else at the time was that the Philippines' net growth in the export sector was to be achieved at the expense of domestic consumption.

3. While lumber exports registered a remarkable 130% increase and plywood exports 39% annually during these periods, the figures in the production side reveal a different picture. Plywood production declined 15% annually and lumber production registered only a moderate 21% increase. These observations could only suggest that the net increase in exports was essentially taken out of domestic consumption.

4. A closer look at the performance of its competitors in trade shows some enviable situations for the Philippines. During the 1976-1981 period, Malaysia's lumber exports registered an annual increase of 74% over the 1970-1975 average. In plywood exports, this figure was 82% with no appreciable change in veneer exports. Indonesia's growth in these sectors was even more impressive - 352% increase in lumber exports and the rapid development of its plywood industry which made the country rise from a net plywood importer in 1974 to the region's dominant plywood producer-exporter in 1981 (Table 5a). Drawing parallels from their experience, it seems reasonable to assume that the Philippines could have attained its goal of expanding its forest products sector and still maintained a respectable flow of log exports to keep foreign exchange inflows relatively stable.

For the Philippines, these average statistics indicate the unsettling revelation that the much-vaunted development of the forest products industries did not materialize and could not be brought about by the log export ban. The government grossly overestimated the capacity of the log export policy to institute positive changes in the product sector. It is clear now that those "expectations" may have been good rallying points to turn public sympathy towards the log export ban, but they certainly could not and most probably will not materialize without the proper blend of market forces and other supportive government interventions.

Simulation #1 - Philippine Unilateral Log Export Embargo

This simulation assumes that all log production in the Philippines is processed locally. Table 6 summarizes the salient implications of the simulation in terms of regional trade and domestic costs.

1. Assuming that Philippine allowable cut is 6.45 million cu.m., the log export ban results in only 91% of the AC being utilized. Indonesia-Malaysia consequently increases its log production by 2.4% and its log exports by 5.4%.

2. The Philippines channels almost 50% more logs to the processing sectors for conversion into lumber (24% more) and plywood (74% more).

Table 6 - Policy Simulation #1
Philippine Unilateral Log Export Embargo

	Philippines		Indonesia-Malaysia	
	Base	Simulation	Base	Simulation
Logs to Lumber	1946	2412	14215	14071
Logs to Plywood	1989	3464	1362	15139
Log Production	6450	5876	42096	43095
Lumber Production	1112	1378	8117	8034
Plywood Production	795	1386	544	427
Log Exports	2515	0	26513	27954
Lumber Exports	0	0	3454	3396
Plywood Exports	174	752	121	0
Log Prices	84	-	85	88
Lumber Prices	264	218	198	202
Plywood Prices	285	273	278	272

Volumes are in 1000 cu.m. Prices are in $/cu.m.

The extra production in the lumber sector is absorbed wholly by the domestic market, while plywood exports rise 332%.

3. In Indonesia-Malaysia, the Philippine log export ban results in a 1.68% decrease in lumber exports and a 1% decrease in lumber production. Plywood exports drop to zero as the Philippines literally "steals" all its plywood exports while a 22% decline in its plywood production is observed. This scenario is clearly logical in the sense that the Philippines, being a more experienced plywood processor than either Malaysia or Indonesia, enjoys a competitive advantage over these countries in plywood and other panel products.

4. Lumber prices in the Philippines drop 17% as the domestic market absorbs the extra production, and the plywood prices drop a moderate 4% due to the resulting vigorous plywood trade. In Indonesia-Malaysia, log prices increase 3.5% in response to the stimulated log export market while plywood prices drop 2.2% due to the weaker plywood trade caused by the Philippines' improved trading position in plywood. Lumber prices, on the other hand, increase 2%. Assuming no change in domestic demand, this rise is explained fully by the drop in lumber production.

5. To the Philippines, the improvement in plywood trade as a result of the log export ban translates to additional receipts of $158 million. The trade off is lost receipts from log exports which amounts to $211 million based on 1980 log prices. <u>The total log ban, on purely economic grounds, is therefore bound to result in a net loss in total dollar receipts amounting to some $53 million</u> which is about 20% of estimated total dollar receipts for the base year 1980 from exports.

6. For Indonesia-Malaysia, the Philippine log export ban results in increased dollar receipts from log exports amounting to $126.8 million. Losses in the product market as a direct result of the Philippine policy is $11.5 million in lumber exports and $33.6 million in plywood exports. Net gain for Indonesia-Malaysia is $81.7 million which is approximately 3% of base year 1980 total dollar receipts from timber product exports from those countries.

<u>Summary of Results</u> (Simulation #1)

The indication of a total log ban for the Philippines will not be advantageous to the country in purely economic terms in the short run. In fact, Indonesia-Malaysia will benefit more from the unilateral Philippine log export policy by filling the shortfall in log supplies created by the Philippines. This result validates the earlier general observation based on period average figures discussed in the background to the Philippine log export policy.

Simulation #2 - ASEAN Log Export Embargo

Although the ASEAN log producers have already initiated independent actions towards one form of log export restriction or another, a unified stand by the three major hardwood producers has not yet happened. It is conceded, however, that these countries are rapidly running down their timber reserves and it is only a matter of time before such a formal action takes place.

A total log ban by the ASEAN cartel is expected to cause tremendous dislocation in the log market. This simulation shows the likely effects of such an action on global trade in tropical timber products in the short run. Table 7 is a summary presentation of the changes likely to take place as a result of an ASEAN log embargo.

1. For the Philippines, the embargo sees the channeling of the entire allowable cut to the products sector - 34.25% going to lumber production and 65.75% to plywood production, representing increases of 14% and 113% more logs, respectively, relative to 1980 performance levels. For Indonesia-Malaysia, the embargo will result in a decrease in log production by almost 11 million cu.m. The remainder of the big log export volume is

Table 7 - Policy Simulation #2
ASEAN Log Export Embargo

	Philippines		Indonesia-Malaysia		Africa	
	Base	Simltn	Base	Simltn	Base	Simltn
Logs to Lumber	1946	2209	14215	24607	4940	3441
Logs to Plywood	1989	4241	1362	6525	593	521
Log Exports	2515	0	27052	0	8075	14352
- Japan	534	0	24123	0	0	5939
- Entrepots	1981	0	2929	0	0	2082
- Europe	0	0	0	0	8075	6331
Log Production	6450	6450	42096	31132	13606	18314
Lumber Production	1112	1263	8117	14064	2821	1967
Plywood Production	795	1697	544	2611	237	208
Lumber Exports	0	0	3454	9133	387	0
- Japan	0	0	1446	6694	0	0
- Entrepots	0	0	316	585	0	0
- Europe	0	0	1304	1854	387	0
- USA	0	0	388	339	0	0
Plywood Exports	174	1228	121	2259	0	0
- Japan	0	1228	0	1769	0	0
- Entrepots	0	0	0	490	0	0
- Europe	0	0	0	0	0	0
- USA	174	0	121	0	0	0
Log Prices	84	-	85	61	59	129
Lumber Prices	264	237	198	208	266	302
Plywood Prices	285	400	278	401	560	664

Volumes are in 1000 cu.m. Prices are in $/cu.m.

channelled into processing - 10.4 million cu.m. representing 73% of 1980 figures going to lumber production, and 5.2 million cu.m., representing an increase of 379% over 1980 levels going to plywood production.

2. The Philippines increases lumber production 14% and plywood production 113%, correspondingly increasing its plywood exports more than six times that of the base year, all of it going to Japan which is the country most directly affected by the embargo.

3. Indonesia-Malaysia boosts its lumber production 73% and its lumber export almost doubles the base year figures. Its plywood production shoots up to 380% and its plywood exports increase more than 17 times. As with the Philippines, Japan becomes the major absorber of these export products - taking in 73% of the total lumber exports and 78% of total plywood exports of Indonesia-Malaysia.

4. Lumber prices in the Philippines drop 10% as the expansion of lumber production is not accompanied by a corresponding shift in demand levels, but plywood prices increase 40% due to a greatly expanding plywood demand picture accompanied by big supply shifts in plywood production in ASEAN. In Indonesia-Malaysia, lumber prices increase a slight 5% and plywood prices increase 44% as a result of simultaneous shifts in production and

consumption of lumber and plywood. Log prices drop 28% due to the resulting oversupply of logs in the domestic market.

5. The ASEAN log embargo causes African log production to increase by 78%. Noteworthy is the resulting shipment of almost 6 million cu.m. of logs to Japan and 2 million cu.m. to the Asian entrepots. This is done while African log exports to Europe drop by 22% and all of Africa's lumber exports are forfeited in order to be shipped as logs to Japan and the entrepots. This ASEAN embargo results in higher prices for African products - 118% increase in log prices, 14% in lumber prices, and 19% in domestic plywood prices.

6. For the Philippines, the ASEAN log embargo translates into the forfeiture of all its log exports valued at $211 million. In return, an improved product export picture yields $442 million in gross receipts representing a net gain of $231 million, which is more than 100% return on the "cost of" the log export ban.

7. For Indonesia-Malaysia, this log embargo translates into a loss of $2.3 billion in foreign exchange earnings from log exports alone. The gains realized from the improved product export picture are $1.22 billion from additional lumber exports and $872 million from increased plywood exports, giving a total of $2.04 billion. This tradeoff spells

a net loss of $208 million in foreign exchange receipts from timber product exports of Indonesia-Malaysia for the base year 1980.

8. Africa is bound to benefit immensely from an ASEAN log embargo. Its log export earnings will increase by $1.4 billion representing a 300% increase over the base year 1980 figure. This bonanza is in exchange for sacrificing its lumber exports to Europe worth $103 million in 1980. The net gain for Africa is therefore a $1.3 billion increase in foreign exchange receipts.

Summary of Results (Simulation #2)

Although the Philippines would gain from an ASEAN log embargo, the major producers, Indonesia and Malaysia, are bound to lose a little. The net loss is actually very small considering that the return to these countries is an abatement of its rapid log extraction rate through a substantial decrease in log production. Ironically, Africa will emerge the big winner amidst the setting of an ASEAN log export embargo, by cashing-in on the lucrative tropical log export market multilaterally defaulted by the ASEAN producers.

Simulations #3 and #4 - Liberalized Philippine Log Export Policy

This simulation is cast in a situation that is reminiscent of pre-1976 years when trade in Philippine logs was unrestricted, along with lumber, plywood,and other products. Two simulation runs were made along this policy option - the first using an allowable cut of 8.0 million cu.m. which level was noted in the early seventies, and the second using an allowable cut of 10 million cu.m. - a figure more closely associated with levels in the late 60's.

Table 8 summarizes the likely trends arising from this Philippine policy alternative in the 80's. The resulting trade and production scenarios in Indonesia-Malaysia and Africa are likewise presented.

1. Offhand, the obvious implication for the Philippines, judging from the imperceptible changes in lumber and plywood production, is that the additional allowable cut (over and above 6.45 million cu.m.) will be simply exported. No other significant changes inthe domestic and export picture are visible for the Philippines.

2. For Indonesia-Malaysia, this Philippine policy will result in less logs exported to Japan and the entrepots. In both simulations, the decreases in volume exports are 1.6 million cu.m. and 3.4 million cu.m., respectively - corresponding roughly to the increases in Philipping allowable cut, i.e., 1.55 million cu.m. and 3.55 million cu.m., respectively. No appreciable change in activities in the products side is indicated,

Table 8 - Policy Simulations #3 & #4
Liberalized Philippine Log Export Policy

Simulation 3 - Philippines Allowable Cut at 8.0 million cu.m.
Simulation 4 - Philippines Allowable Cut at 10.0 million cu.m.

	Philippines			Indonesia-Malaysia			Africa		
	Base	S-3	S-4	Base	S-3	S-4	Base	S-3	S-4
Logs to lumber	1946	1964	1985	14215	14343	14738	4940	4894	4862
Logs to Plywood	1989	1989	2017	1362	1385	1430	593	593	594
Log Exports	2515	4047	6998	27052	25418	23652	8075	8068	8064
- Japan	534	2051	3996	24123	22386	20563	0	0	0
- Entrepots	1981	1996	3002	2929	3032	3089	0	0	0
- Europe	0	0	0	0	0	0	8075	8068	8064
Log Production	6450	8000	10000	42096	41145	39821	13606	13556	13521
Lumber Production	1112	1122	1134	8117	8188	8411	2821	2796	2777
Plywood Production	795	795	806	544	553	571	237	237	237
Lumber Exports	0	0	0	3454	3489	3673	387	312	258
- Japan	0	0	0	1446	1301	1325	0	0	0
- Entrepots	0	0	0	316	335	359	0	0	0
- Europe	0	0	0	1304	1454	1576	387	312	258
- USA	0	0	0	388	399	413	0	0	0
Plywood Exports	174	169	173	121	127	142	0	0	0
- Japan	0	0	0	0	0	0	0	0	0
- Entrepots	0	0	0	0	0	0	0	0	0
- Europe	0	0	0	0	0	0	0	0	0
- USA	174	169	173	121	127	142	0	0	0
Log Prices	84	81	78	85	83	80	59	58	57
Lumber Prices	264	262	260	198	195	193	266	262	259
Plywood Prices	285	280	274	278	273	268	560	559	558

Volumes are in 1000 cu.m. and prices are in $ per cu.m.

except for a slight increase in lumber production (Simulation #4) which sees the chanelling of an additional 523,000 cu.m. of logs to the lumber sector. This results in an increase in lumber production by 294,000 cu.m. of which 219,000 cu.m. goes to export.

These simulation results show the profound effects of Philippine policy on the region's trade performance. Recall that the unilateral Philippine log export ban (Simulation #1) results in an improved log export picture for Indonesia and Malaysia together. (Likewise, this point was proved by actual trade performance as noted in the background for the Philippine log export policy earlier in this chapter.)

3. Effects of this Philippine policy are almost imperceptible in Africa which is understandable because Africa caters principally to the European market. As no appreciable change is noted in the product side,the effect on Europe is insubstantial, except of the increased volume of Indo-Malaysian lumber exports to that continent arising from the diversion of logs to the lumber sector. This results from the partial dislocation of Indo-Malaysian log exports due to the improved log export performance by the Philippines at the higher allowable cut level of 10 million cu.m.

4. This policy option is certainly attractive as a revenue generating measure for the

Philippine government, being the owner of the timber resource. A higher export tax on logs may be applied for this purpose without appreciably affecting other sectors of the economy. However, the fact that it unilaterally restricted log exports since 1976 is a clear indication of the conservative inclination of the contry as far as securing its timber resources is concerned.

Summary Results (Simulations #3 and #4)

Liberalizing log exports accompanied by increasing allowable cuts indicates very little change in the products sector. This makes this type of policy a promising revenue generating measure. This policy set at a high allowable cut also dislocated partially the log export performance of Indonesia-Malaysia by way of the Philippines displacing its neighbors in the log trade in Japan and the Asian entrepots. (This seems consistent with the preference for Philippine Mahogany logs by importers. Although the Philippine Mahogany and Indo-Malaysian meranti logs belong to the same family and genera, the former are claimed to be of a better wood quality than the latter.)

Simulations #5-#8 - Tariff Alternatives to Quantitative Restrictions

For this policy issue, four different simulations were made:

Simulation #5: Imposition of an additional 5% export tax on Philippin timber products.

Simulation #6: The current 4% export tax is lifted. Allowable cut set at 1980 level with no log export restrictions.

Simulation #7: Same as Simulation#6 except that allowable cut is increased to 7.45 million cu.m.

Simulation #8: Same as Simulation #6, but with a total log export ban.

For this particular set of simulations only, a different base year simulation was used, featuring a better export picture in lumber - something that was not immediately available from the previous base year simulation.

The 5% Additional Export Tax

Theory states that an additional export tariff acts as a price wedge that sets the price of a commodity above the equilibrium price. The effect is an over supply situation since at the higher price, the demanders consume less of the commodity while the producers want to produce more. During the adjustment process the suppliers reduce their production levels to meet the reduced quantity demanded. Whether or not such a policy is effective depends upon the elasticity of the demand curve (Figure 5). Table 9 presents the results of this tariff option including the 3 variations of the current policy issue.

1. As expected, the 5% tax reduced lumber exports (82%) and plywood exports (49%). Log exports, however, increased by 15% suggesting that the log sector is a comparatively more lucrative profit center than either of the products. Total lumber and plywood production decrease by 7.6% and 8.8%, respectively. This is presumably prompted by the disincentive of the export tariff.

   In value terms, such a policy would yield a net earning of $31 million from log exports. This is offset by a decline in lumber export earnings of $29.3 million and in plywood exports $25.0 million. The net loss arising from such a policy would amount to $23.3 million or 8.4% of total base year gross receipts from exports.

2. For Indonesia-Malaysia, this Philippine tariff translates into lumber exports registering a slight 1.6% increase in volume, and plywood exports increasing by almost 30%. Its log export performance, however, is not appreciably affected. Although the increase in Philippine log exports is not inconsequential, the volume involved (taken away from Indo-Malaysian log exports) is very small compared to the total volume being exported. This policy, in value terms, translates into

Table 9 - Policy Simulations #5 - #8

Effect of Export Tariffs on Philippine Products

Simulation 5 - An additional 5% export tax on Philippine products.
Simulation 6 - Lifting of the current 4% export tax on Philippine products with allowable cut at 6.45 million cu.m. and no log export restrictions.
Simulation 7 - Same as Simulation No. 6 with allowable cut at 7.45 million cu.m.
Simulation 8 - Same as Simulation No. 6 but with a total log export ban.

	Philippines					Indonesia-Malaysia				
	Base	S-5	S-6	S-7	S-8	Base	S-5	S-6	S-7	S-8
Logs to lumber	2144	1982	2221	2225	3125	14078	14168	13964	14006	13534
Logs to Plywood	1984	1808	2069	2071	3298	1363	1450	1327	1345	1104
Log Exports	2322	2660	2161	3154	0	26654	26489	26776	26106	27955
- Japan	343	676	180	1163	0	23723	23489	23872	23172	23316
- Entrepots	1979	1984	1981	1991	0	2931	3000	2904	2934	4639
- Europe	0	0	0	0	0	0	0	0	0	0
Log Production	6450	6450	6450	7450	6450	42095	42108	42066	41459	42594
Lumber Production	1225	1132	1268	1271	1800	8037	8089	7970	7995	7725
Plywood Production	793	723	827	828	1318	544	579	530	537	441
Lumber Exports	175	31	263	253	777	3353	3406	3283	3289	3032
- Japan	0	0	0	0	381	1495	1425	1498	1379	1330
- Entrepots	0	0	0	0	0	311	315	311	318	339
- Europe	0	0	0	0	0	1336	1308	1343	1446	1363
- USA	175	31	263	253	396	211	358	131	146	0
Plywood Exports	171	87	219	218	699	121	157	104	111	13
- Japan	0	0	0	0	122	0	0	0	0	13
- Entrepots	0	0	0	0	0	0	0	0	0	0
- Europe	0	0	0	0	57	0	0	0	0	0
- USA	171	87	219	218	520	121	157	104	111	0
Log Prices	84	85	84	83	31	85	85	85	84	87
Lumber Prices	201	188	210	208	209	198	198	197	196	197
Plywood Prices	285	273	295	292	284	278	281	277	273	270

Volumes are in 1000 cu.m. and prices are in $ per cu.m.

Table 9 - Policy Simulations #5 - #8 (Continued)

Effect of Export Tariffs on Philippine Products

Simulation 5 - An additional 5% export tax on Philippine products.
Simulation 6 - Lifting of the current 4% export tax on Philippine products with allowable cut at 6.45 million cu.m. and no log export restrictions.
Simulation 7 - Same as Simulation No. 6 with allowable cut at 7.45 million cu.m.
Simulation 8 - Same as Simulation No. 6 but with a total log export ban.

			Africa		
	Base	S-5	S-6	S-7	S-8
Logs to lumber	4930	4941	4933	4898	4950
Logs to Plywood	593	593	593	593	593
Log Exports	8075	8071	8067	7824	7979
- Japan	0	0	0	0	0
- Entrepots	0	0	0	0	0
- Europe	8075	8071	8067	7824	7979
Log Production	13598	13606	13592	13553	13523
Lumber Production	2816	2823	2818	2798	2828
Plywood Production	237	237	237	237	237
Lumber Exports	373	372	357	316	350
- Japan	0	0	0	0	0
- Entrepots	0	0	0	0	0
- Europe	373	372	357	316	350
- USA	0	0	0	0	0
Plywood Exports	0	0	0	0	0
- Japan	0	0	0	0	0
- Entrepots	0	0	0	0	0
- Europe	0	0	0	0	0
- USA	0	0	0	0	0
Log Prices	59	59	58	58	60
Lumber Prices	265	264	265	262	264
Plywood Prices	560	560	560	559	559

gross increases of \$10.5 million in lumber exports and another \$10.5 million in plywood exports. The trade off in terms of lost log exports is \$14.0 million. This puts the net gain by Indonesia-Malaysia to \$7.0 million, which is very small relative to the base year total export receipts of \$2.96 billion.

3. As shown, the effect on Africa is negligible.

Lifting the 4% Export Tax

The 3 variations of this policy alternative are discussed jointly hereunder in order to provide a clearer comparison of simulated states. This export tarif acting in the opposite direction, is expected to generate the exact opposite effect to the 5% additional tariff of the previous section.

1. The lifting of the 4% export tax on Philippine products, as expected, boosts its export performance. Lumber exports rise 50% and plywood exports, 28%. At the 1980 allowable cut level of 6.45 million cu.m., this improved product export picture causes the diversion of some 161,000 cu.m. of logs from the log export market to processing. In value terms, this diversion divests \$13.5 million from log export earnings. The trade offs, however, are \$20 million additional earnings from lumber exports, and \$15.9 million from plywood exports. Net gain to

the Philippines is $22.4 million in additional foreign exchange receipts.

2. The effect of this tariff option to Indonesia-Malaysia is a slight reduction in dollar receipts from lumber exports ($17.1 million) and from plywood exports ($4.8 million). This slight decline is partly compensated for by a slight increase in log exports ($10.4 million). To Indonesia-Malaysia, the net loss is a trickle - $11.5 million representing less than one-half of one percent of total gross receipts from exports during the base year.

3. Total value of the 4% tariff if generated would have meant some $11.2 million revenues to the Philippine government during the base year, which loss is 50% of the total net receipts to the exporting sector. As a policy option, the lifting of the 4% export tax must be evaluated not only on the basis of gains or losses to the export sector, but also in revenues foregone. The government will recover the "cost" of implementing this policy through increased collections from corporate and capital gains taxes, but whether or not such an increase is sufficient to fully recover the foregone revenues is a matter that implicates a broader economic base for analysis. For example, increased employment through an increased activity in wood processing must somehow be incorporated in determining social and economic effects.

4. Increasing the allowable cut by 1 million cu.m. while lifting the 4% export tax (Simulation #7) indicates substantially the same improvement in processing activity as Simulation #6 (3.8% higher in lumber production and 4.4% higher in plywood production), as 83% of the extra allowable cut is simply exported as sawlogs. This is borne out by previous Simulations #3 and #4 involving increases in the allowable cut. The slightly better export picture results in higher domestic lumber prices (3.5%) and plywood prices (2.5%).

5. At this point, Simulation #7, there is a noticeable effect on the Euro-African log market, as African log exports drop to 3.1%. This is traced back to a decline in European log imports brought about by Europe's increased imports of Indo-Malaysian lumber (8.23%), which volume was taken out of (would-be) lumber exports to Japan by Indo-Malaysia, and which, in turn, is caused by the extra logs imported by Japan from the Philippines. This is probably one of the most intricate simulated interactions in world tropical trade that was brought about by a combination of trade policy (tariff) and a forest policy (allowable cut).

6. Except for a 2% reduction in Indonesia-Malaysia's log export volume, this Philippine policy's effects on the product exports of

that region are substantially the same as Simulation #6. Again, this trend of the Philippines edging out its neighbors in the log export market, if and when it can, is borne out by previous simulations.

7. Lifting the 4% export tax during a total Philippine log ban policy (Simulation #8) is certainly an appropriate combination - one acting as incentive towards the implementation of the other. As shown in Table 9, the effects are decidedly dramatic.

8. For the Philippines´ processing sector, lumber production increases 50% and plywood production 66%. Lumber exports register a 344% increase in volume, and plywood exports 309%. All these are accomplished at the expense of Indo-Malaysian product exports (9.6% lower for lumber and 89% lower for plywood). However, due to the ban, Indo-Malaysia boosts its log exports by 1.3 million cu.m. The effect of Africa is almost imperceptible as the trade offs occur principally between the Philippines and its neighbors - Indonesia and Malaysia.

9. In value terms, such a policy spells for the Philippines, the forfeiture of some $195 million of dollar receipts from log exports. In return, an improved product export picture yields $127 million in additional exoprt earnings from lumber, and $150 million from plywood. The net gain in export earnings comes to $82 million.

10. For Indonesia-Malaysia, the effect is translated into reduced receipts from product exports ($67 million in lumber exports and $18 million in plywood exports). The improved log exports, however, yield an additional $166 million in receipts. Thus, the net gain in export earnings for Indo-Malaysia is some $81 million in additional foreign exchange receipts.

11. Although both producers benefit from the imposition of such a Philippine policy (Simulation #8), it is doubtful whether Indonesia and Malaysia would subscribe for long, as they themselves are in the process of securing their own timber reserves. A policy of increasing log exports and production is obviously not appropriate in the direction of that conservationist objective.

Simulations #9 and #10 - Trade Liberalization in ASEAN

Being self-sufficent in timber products, the major ASEAN producers never actively traded with each other in logs, lumber, or plywood. They do cater to the same markets, however, to Japan and the Asian entrepots for their logs, and to the US, Japan, Europe and Australia for their lumber and panel products. They likewise sell practically the same commodities (logs, lumber, plywood and veneer made of diptero-carp and other tropical hardwood species). The possibility exists that these countries might actually benefit by trading among themselves in both logs and products, and still maintain their trading positions relative to the rest of the world.

Two simulation runs were conducted to examine this possiblity. Simulation #9 implements the liberalization of trade among the three ASEAN producers with the Philippine allowable cut pegged at 1980 levels (6.45 million cu.m.). Simulation #10 is the same as Simulation #9 with the Philippine allowable cut pegged at 8.0 million cu.m. (The recurrence of policy simulations wherein two or more levels of allowable cut are involved is necessary because of the absence of a price-responsive log supply function for the Philippines.) Table 10 summarizes the salient results of the 2 simulation runs.

1. According to the simulations, it is in the best interest of the Philippines to export all its surplus logs to Indonesia-Malaysia, and even divert some 0.34 million cu.m. of logs from processing to log export. At the same time, Indo-Malaysia ships out some 0.44 million cu.m. of its lumber to the Philippines, which drops 17.4% of its own lumber production to absorb the cheaper lumber from its neighbor. The Philippines-Entrepots log trade is then entirely covered by Indo-Malaysia.

2. An interesting result from these simulations is the simultaneous shipment of logs from the

Table 10 - Policy Simulations #9 & #10
Trade Liberalization Within ASEAN

Assumption: - Simultaneous Shipments of logs and products is made possible within the ASEAN countries.
Simulation #9-Philippines Allowable Cut at 6.45 million cu.m.
Simulation #10-Philippines Allowable Cut at 8.0 million cu.m.

	Philippines			Indonesia-Malaysia		
	Base	S-9	S-10	Base	S-9	S-10
Logs to Lumber	1946	1608	1619	14215	9691	8373
Logs to Plywood	1989	0	0	1362	1373	1406
Log Exports	2515	4842	6381	27052	29222	29467
- Japan	534	0	0	24123	24302	24496
- Entrepots	1981	0	0	2929	4920	4971
- Europe	0	0	0	0	0	0
- Philippines	0	0	0	0	1942	1967
- Indo-Malaysia	0	4842	6381	0	0	0
Log Production	6450	6450	8000	42096	42229	41213
Lumber Production	1112	919	925	8117	8301	8424
Plywood Production	795	777	786	544	549	562
Lumber Exports	0	0	0	3454	3222	3305
- Japan	0	0	0	1446	1309	1266
- Entrepots	0	0	0	316	302	319
- Europe	0	0	0	1304	1233	1330
- USA	0	0	0	388	378	390
- Philippines	0	0	0	0	441	450
- Indo-Malaysia	0	0	0	0	0	0
Plywood Exports	174	156	161	121	126	136
- Japan	0	0	0	0	0	0
- Entrepots	0	0	0	0	0	0
- Europe	0	0	0	0	0	0
- USA	174	156	161	121	126	136
- Philippines	0	0	0	0	0	0
- Indo-Malaysia	0	0	0	0	0	0
Log Prices	84	87	84	85	86	84
Lumber Prices	264	221	291	198	201	198
Plywood Prices	285	286	282	278	279	275

Volumes are in 1000 cu.m. Prices are in $/cu.m.

Philippines to Indo-Malaysia and back. Due to the structure of the problem as set up in the algorithm, this is made possible only because the logs shipped to Indo-Malaysia are intended specifically for lumber production, and the shipments of logs from Indo-Malaysia to the Philippines are for plywood processing. It is not clear how much differentiation in log quality occurs in lumber and plywood processing in real life. To some extent, there actually is, but in practice it does not seem logical for such an occurrence to take place in the ASEAN log market. Yet, this result is theoretically appealing since once of the basic limitations of the reactive programming algorithm is its inability to simulate "cross-hauls", or the simultaneous shipment of the same product across the same route.

3. Lumber prices in the Philippines drop significantly (16%) as a result of the infusion of cheaper lumber from Indo-Malaysia.

4. Except for the above changes, which are essentially contained in the ASEAN region, there is very little perturbation in the plywood sector and the prices of logs, plywood, and lumber remain basically the same as the base year figures.

5. Trade offs occurring in the resulting liberalized trade among these countries may be summarized as follows for the two levels

of allowable cut (AC_1 = 6.45 million cu.m., AC_2 = 8.0 million cu.m.):

Philippines		AC_1	AC_2
		(Million $)	
a) Extra receipts from log exports	=	210	325
b) Less log imports	=	(167)	(165)
c) Less lumber imports	=	(89)	(89)
Net Gain/(Loss)	=	(46)	71

Indonesia-Malaysia			
a) Extra receipts fro log exports	=	463	424
b) Losses in lumber exports	=	(36)	(30)
Net Gain/(Loss)	=	427	394

Summary Results (Simulations #9 and #10)

The Philippines ultimately gains in net foreign exchange receipts from this policy if it increases its allowable cut to 8.0 million cu.m. Curiously, this possibility has never been seriously pondered by the ASEAN. There does exist a small amount of log trade between Indonesia (Sumatra) and West Malaysia (Peninsular), but the volume is very small compared to the entire ASEAN transactions. It appears from the results that Indo-Malaysia will benefit substantially from such a trade liberalization policy.

Simulations #11 and #12 - <u>Exchange Rate Effect</u>

A major devaluation of a country's currency represents in conditional terms a "cheapening effect" on its exports relative to the rest of the world. If the factors of production are predominantly locally abundant, such devaluation becomes what is commonly referred to as a "beggar thy neighbor" policy. It automatically gives its products competitive advantage in the world market. In the Philippine forestry sector, however, it is not clear how a currency devaluation will affect forest products exports. For one thing, many of the inputs in production are imported, i.e., logging and wood processing equipment and energy are factors heavily imported by the Philippines. Although the Philippines produces oil, it still imports more than 50% of its domestic energy requirements.

In 1984, due to worsening balance-of-payment problems and increasing problems in the repayment of overdue loans at the major world financing institutions, the Philippines devalued its currency from 9.69 pesos per US dollar to 17 pesos per US dollar. Because of the "beggar thy neighbor effect", it is expected that Philippine exports experience greatly improved foreign demand shifts. Actual performance data of the forest products export sector for 1985 are not yet available, however, and it might take a little longer to compile the desired information for comparison with the following simulation results.

Table 11 shows the results of a major Philippine currency devaluation at two levels of allowable cut: (a) 6.45 million cu.m. allowable cut which does not allow great flexibility for the expected perking up of product exports, and (b) 8.0 million cu.m. which permits sufficient raw material procurement to meet and expected surge in foreign demand for the "cheaper" Philippine products.

1. Simulation #11 (lower allowable cut) indicates no substantive change in log export volumes and prices. This is understandable as very little flexibility is permitted by the low allowable cut. In fact, the expected surge in product exports (377,000 cu.m. of lumber, and 452,000 cu.m. of plywood) is essentially the result of drawing away 377,000 cu.m. of lumber and 138,000 cu.m. of plywood from domestic consumption to export. The currency devaluation depresses lumber prices 25% and plywood prices 7%.

2. The surge in Philippine product exports is achieved at the expense of Indo-Malaysia which loses 443,000 cu.m. of lumber exports representing 14% of gross earnings from lumber exports during the base year, and all of its base year exports of plywood worth $34 million. This is clearly the "beggar thy

Table 11 - Policy Simulations #11 & #12
Exchange Rate Effect

Assumption: - Philippine exchange rate from 9.69/US$ to 17/US$

Simulation #11-Philippines Allowable Cut at 6.45 million cu.m.
Simulation #12-Philippines Allowable Cut at 8.0 million cu.m.

	Philippines			Indonesia-Malaysia		
	Base	S-11	S-12	Base	S-11	S-12
Logs to Lumber	1946	1764	1819	14215	14064	14225
Logs to Plywood	1989	2220	2313	1362	1078	1084
Logs Exports	2515	2466	3868	27052	26246	25056
- Japan	534	485	1875	24123	23671	22424
- Entrepots	1981	1981	1993	2929	2575	2632
- Europe	0	0	0	0	0	0
Log Production	6450	6450	8000	42096	41388	40365
Lumber Production	1112	1007	1039	8117	8031	8121
Plywood Production	795	1009	1051	544	431	432
Lumber Exports	0	337	386	3454	3011	3368
- Japan	0	0	0	1446	1480	1402
- Entrepots	0	0	0	316	33	348
- Europe	0	0	0	1304	1476	1589
- USA	0	377	386	388	22	29
Plywood Exports	174	626	838	121	0	0
- Japan	0	0	21	0	0	0
- Entrepots	0	0	0	0	0	0
- Europe	0	0	644	0	0	0
- USA	174	626	173	121	0	0
Log Prices	84	83	79	85	84	82
Lumber Prices	264	197	195	198	195	192
Plywood Prices	285	266	264	278	265	262

Volumes are in 1000 cu.m. Prices are in $/cu.m.

neighbor" effect that is the consequence of a major currency devaluation of a competing producer. This effect forces Indo-Malaysia to bring down log production to 2% as shown by the lower volumes of logs channelled to lumber and plywood.

3. Simulation #12 (higher allowable cut), validates earlier observations that increases in allowable cut are simply exported (in this case, an additional 1.353 million cu.m. of logs is exported out of the 1.55 million cu.m. extra allowable cut). A slight change in lumber exports is noted but an increase of 212,000 cu.m. of plywood exports over the previous simulatio and representing a 382% increase over the base year figure is indicated.

4. The "beggar thy neighbor" effect on Indo-Malaysia occurs in log and plywood exports, in contrast to lumber and plywood in the previous simulation. This dislocation in Indo-Malaysian log exports occurs because of the increased log exports of the Philippines (due to the extra allowable cut) at lower export prices. The effect on Indo-Malaysian plywood exports is the same as the previous simulation - Indo-Malaysia loses out completely to the Philippines.

5. In value terms, this currency devaluation spells the following for the ASEAN producers: (AC_1 = 6.45 million and AC_2 = 8.0 million cu.m.)

Philippines		Allowable Cut	
		AC_1	AC_2
		(Million $)	
a) Additional lumber exports	=	74.3	75.3
b) Additional plywood exports	=	116.9	171.6
c) Additional log exports	=	(6.6)	94.3
Total Net Gain/(Loss)	=	184.6	341.2
Indo-Malaysia			
a) Additional lumber exports	=	(96.7)	(37.2)
b) Additional plywood exports	=	(33.6)	(33.6)
c) Additional log exports	=	(94.8)	(244.8)
Total Net Gain/(Loss)	=	(225.1)	(315.6)

Clearly, the "beggar thy neighbor" effect on Indo-Malaysia is a hefty $225.1 million of the Philippines does not increase its allowable cut, and $315.6 million under an expanded Philippine allowable cut. These losses represent 7.5% and 10.5% of total gross dollar receipts from log and product exports during the base year.

To the Philippines, the short-term gains from a currency devaluation are substantial, in this case, 71% and 131% of base year gross dollar receipts under the two allowable cut levels, respectively.

Summary Results (Simulations #11 and #12)

A major devaluation of the Philippine peso clearly demonstrates the "beggar thy neighbor" effect - the devaluating country (Philippines) practically "stealing" away the market from its competitors (Indo-Malaysia). The gains to the Philippines (and the losses to Indo-Malaysia) correspondingly increase as Philippine allowable cut is expanded to meet the expected surge in foreign demand.

Addendum Simulation

Expansion of Philippine Production of Lumber and Plywood

This policy simulation was not originally included in the listing of intended simulations, but is incorporated here due to its interesting insights. The policy situation presented is a doubling of production capacities and then the effects on trade simulated. Although it is conceded that such an expansion of capacities cannot be immediately implemented in reality, such a policy can actually be adopted by government. For example, a vigorous production program in plywood and lumber can be adopted as an industrialization policy. Necessarily, the allowable cut has to be increased in order to respond to additional raw material requirements. Table 12 presents the salient results of this simulation for the Philippines and Indo-Malaysia.

To implement this simulation, the supply equations for lumber and plywood undergo parallel shifts to the right,

Table 12 - Addendum Simulation
Expansion of Philippine Production of Sawnwood and Plywood

Assumption: Philippine supply equations for lumber and plywood undergo parallel shifts to the right approximately twice the current or base level.

	Philippines		Indonesia-Malaysia	
	Base	Simulation	Base	Simulation
Logs to Lumber	1946	3060	14215	14794
Logs to Plywood	1989	3588	1362	1094
Log Exports	2515	6253	27052	22766
- Japan	534	4248	24123	20156
- Entrepots	1981	2005	2929	2610
- Europe	0	0	0	0
Log Production	6450	12900	42096	38655
Lumber Production	1112	1748	8117	8442
Plywood Production	795	1434	544	436
Lumber Exports	0	227	3454	3661
- Japan	0	0	1446	1392
- Entrepots	0	0	316	364
- Europe	0	0	1304	1708
- USA	0	227	388	197
Plywood Exports	174	774	121	0
- Japan	0	54	0	0
- Entrepots	0	0	0	0
- Europe	0	0	0	0
- USA	174	720	121	0
Log Prices	84	77	85	79
Lumber Prices	264	193	198	189
Plywood Prices	285	255	278	254

Volumes are in 1000 cu.m. Prices are US$ per cu.m.

approximately twice the current or base level. Correspondingly, the base year allowable cut level of 6.45 million cu.m. for the Philippines is doubled.

1. This policy results in increases in lumber production by 57% and plywood production by 80%. Lumber exports increase by 227,000 cu.m. and plywood exports by 600,000 cu.m. Log exports increase by 3.7 million cu.m. representing 58% of the additional allowable cut. Prices drop correspondingly because of the supply shifts: for logs, the drop is 8.3%; for lumber, 27%; and for plywood, 10.5%. Total dollar receipts of the country increase by $462 million which represents a 77% increase over the total base year export earnings.

2. For Indonesia-Malaysia, this Philippine policy results in a 4.3 million cu.m. drop in log exports as 86% of this reduction is displaced by the extra Philippine log exports. Total log production drops by 3.44 million cu.m. which is practically the total additional volume of logs exported by the Philippines. The resulting surplus of domestic logs forces Indo-Malaysia to channel 4.1% more to lumber production, resulting in 6% more lumber exported. Moreover, it is forced to channel 20% less log volume to plywood production as the Philippines practically steals away all its base year exports of plywood. The resulting

contraction in foreign demand for its products causes prices to drop--7% for logs, 5% for lumber and 9% for plywood.

3. The extra log exports of the Philippines is absorbed by Japan which volume is practically drawn against Japan's log imports from Indo-Malaysia during the base year. More than 300,000 cu.m. in log export are denied the Asian entrepots, whose lumber production and export subsequently decline and correspondingly filled by the additional lumber exports of the ASEAN producers. The Philippines, likewise, practically steals away some 425,000 cu.m. of US-bound plywood exports from Japan and the Asian entrepots, as a result of this expansion policy.

Summary Results (Addendum Simulation)

Doubling production capacities and the allowable cut has a positive effect for the Philippines but at the expense of Indo-Malaysia which loses share in the log and plywood trade.

CHAPTER V

SUMMARY, CONCLUSIONS, AND SUGGESTIONS FOR FUTURE RESEARCH

The introduction to this study provides a brief historical backdrop to the evolution of trade and trade policy in the Philippines. It also described the prevailing situation in trade and production of timber products in the Southeast Asian region with a special emphasis on the interaction of the Philippines, Indonesia, and Malaysia.

The objective of this study was to develop a policy model of global trade in tropical logs and forest products with the special role of the Philippines and its ASEAN partners correspondingly emphasized. Proceeding from the development of such a model, relevant short-run policy issues ranging from log export restrictions to currency devaluation were simulated and analyzed with the end in view of determining if such policies will, in essence, result in a better short-run economic state for the Philippines. Trade offs are examined in terms of dollar receipts gained and foregone for each one of the policy issues simulated, and which region gains or loses from such a policy.

A Philippine log export ban is shown to be detrimental to the country, and the lost benefits would accrue to Indo-Malaysia in the short-run. However, a concerted action of the

ASEAN producers to totally ban log exports would result in the Philippines profitting immensely from improved product sales, more than compensating for lost log exports. Indonesia and Malaysia will lose a little from export receipts but this loss is very small compared to the abatement of their rapid log extraction rates through a substantial decrease in log production accompanied by an improved product export picture.

A return to a liberalized state of log trade (no restrictions) would be beneficial to the Philippines through a large increase in log exports as the resulting additional cut will be substantially exported to Japan and the entrepots. Since this policy has very little effect on the products sector, it is a promising government revenue-generating measure to consider. This policy also results in partial dislocation of Indo-Malaysian log exports which are edged out by the preferred Philippine Mahogany logs.

Imposition of a further export tariff in addition to the current 4% rate follows the theoretical price-induced effect of reducing equilibrium quantities. This is observed in lumber and plywood production and exports. However, log exports increase, suggesting that the log export market is a more profitable outlet after the 5% tax has been passed on to input costs in either lumber or plywood processing. This is borne out by Table 5, which shows that (for the Philippines) the product is more elastic with respect to its own price than to its log input price.

Lifting the current 4% export tax is a price support that boosts Philippine products in the export market, in return for lost government revenues. However, the improved trade performance would partially pay back these lost receipts through increased corporate and capital gains taxes. Effect of this policy on Indo-Malaysia and Europe depends to a large extent upon the level of allowable cut imposed by the Philippines. Such effect translates into changes in the pattern of log and product importations by the major consuming regions, Europe and Japan.

Lifting the 4% tax and at the same time banning log exports of the Philippines results in dramatic increases in Philippine production of trade in lumber and plywood. However, this is achieved only at the expense of Indo-Malaysia´s product exports, but it nets from this policy through a boost in log exports left out by the Philippines through its log export ban.

A policy of liberalizing trade among the ASEAN producers (something that was never actively done before because of these countries´ self-sufficiency in timber products), results in the ASEAN producers mutually and simultaneously benefitting, but for the Philippines, this can come only at a higher allowable cut of 8.0 million cu.m. or more.

A devaluation of the Philippine peso demonstrates the "beggar thy neighbor" effect with Indo-Malaysia suffering immensely from the induced price-reduction of Philippine products. Such an effect intensifies (more gain for the Philippines, more losses for Indo-Malaysia) at higher levels of allowable cut for the Philippines.

An addendum simulation was run to determine the trade effects of the Philippines "suddenly" doubling its production capacities. The result is positive for the Philippines due to large increases in production and export receipts, but this is done at the expense of Indo-Malaysia which miserably loses out in the log and plywood trade.

Conclusions

These results show the close linkage of the economies of the ASEAN producers and their profound effect on global trade in timber products. These strong linkages justify the necessity to consider the aspect of global and regional trade, if and when specific trade and forest policies are being contemplated by incumbent governments, especially those major producing regions which often exercise one form of market intervention or another. It might do well for the Philippines in particular, and ASEAN in general, to consider the results of two simulations - one dealing with a concerted action of the ASEAN producers to ban all log exports, and the other dealing with the possibility of liberalizing trade among the ASEAN member countries in timber products. This model showed the short-run benefits that might accrue to the ASEAN producers should they undertake these policies. However, these indications are purely economic. Surely, there are other (non-economic) reasons that must be likewise considered before firming up decisions that can potentially affect the current atmosphere of regional cooperation within ASEAN today.

Beyond everything else, this study showed the feasibility of modeling world trade in the tropical components of forest products, and such a model can be effectively harnessed to evaluate specific short-run policies, not only in terms of their price effects, but also in terms of their socio-political implications.

Suggestions for Future Research

There are several aspects of the present research as far as the model itself is concerned that merit further attention. First, the problem of inadequate data will present continued difficulties. As long as the tropical components of forest products are not properly identified and published, demand and supply estimates of the same (in the major consuming regions) will always involve a reasonable amount of guesswork. Future efforts in this direction should concentrate on the more accurate determination of tropical trade flows and developing better ways of isolating the tropical components of forest products consumption and production in regions like Europe, USA, Japan, and the Asian entrepots.

Second, to introduce dynamism into the model, the supply functions must include other factor costs and technological variables, in addition to the usual log input costs and product prices. An expanded model could simulate medium-term and longer-term policies that involve capacity changes, investment alternatives, labor productivity, end-use technology, and product substitution among others. Such a model could then be harnessed to produce various scenarios out of medium- and long-term policies on trade and commerse.

Third, the potent effect of Latin America in timber trade in the medium-term is a reality that cannot be ignored. Hence, future modeling work should include it as a major endogenous producing and consuming region.

Fourth, Indonesia and Malaysia should, by right, be modeled separately as these two countries are individually bigger and more potent in timber trade than the Philippines. Besides, the trade policies that are adopted by these countries are not necessarily the same and may even run in opposite directions.

Fifth, to be effective as a planning tool for national development, this model's Philippine component must be vastly expanded to include a better end-use indicator of timber products consumption, product substitution, and production capacity.

Finally, strong effort must be directed towards the gathering of timely data on freight costs of timber products between major shipping points, and provide good estimates of such costs for less active sea routes. Reliable freight (transport costs) figures are critical to the model solution algorithm, hence they must be carefully determined.

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APPENDICES

APPENDIX 1

SUPPLY AND DEMAND EQUATIONS

APPENDIX 1a - Demand Equations* for Tropical Hardwood Sawnwood

1. PHILIPPINES

$$D_P^{st}/E_{1P} = \underset{(9.99)}{2645.644} - \underset{(-3.62)}{0.600293}(P_P^{st}/PS_P) - 727.9144U_{1P}$$

$$R^2 = 0.82; \quad DW = 1.78; \quad n = 1964\text{-}81$$

2. INDONESIA-MALAYSIA

$$D_I^{st} = \underset{(6.21)}{30.266}E_I - \underset{(-2.03)}{11.233}(P_I^{st}/PS_I) + \underset{(4.82)}{4005.72}$$

$$R^2 = 0.73; \quad DW = 0.94; \quad n = 1964\text{-}81$$

3. ASIAN ENTREPOTS

$$D_N^{st} = \underset{(5.84)}{24.963}E_N - \underset{(-1.93)}{7.7898}(P_N^{st}/PS_N) + 1548.603$$

$$R^2 = 0.78; \quad DW = 1.50; \quad n = 1964\text{-}81$$

4. JAPAN

$$D_J^{st} = \underset{(7.78)}{54.158}E_J - \underset{(-3.16)}{5.4798}(P_J^{st}/PS_J) + \underset{(5.00)}{2747.73} - \underset{(-6.23)}{2741.33}U_{1J}$$

$$R^2 = 0.85; \quad DW = 1.92; \quad n = 1964\text{-}81$$

5. U.S.A.

$$D_U^{st} = \underset{(4.00)}{0.4844}E_U - \underset{(-5.58)}{5.0469}(P_U^{st}/PS_U) + \underset{(1.55)}{3.1797}(P_U^{sn}/PS_U) + \underset{(10.9)}{148.2}$$

$$R^2 = 0.76; \quad DW = 2.11; \quad n = 1964\text{-}81$$

Figures in parentheses below coefficients are "t" statistics.

*See Appendix 2 for definition of variables.

6. EUROPE**

$$(D_E^{sn}/E_E) = \underset{/23.99/}{300.13} - \underset{/0.263/}{1.0221}\ (P_E^{sn}/PS_E);$$

$$R^2 = 0.54; \quad DW = 0.80; \quad n = 1967\text{-}80$$

$$(D_E^{st}/D_E^{SN} = \underset{/0.04/}{0.61806} - \underset{/0.026/}{0.26211}\ (P_E^{st}/PS_E) - 0.09508\ U_{1E};$$

$$R^2 = 0.90; \quad DW = 1.90; \quad n = 1966\text{-}75;\ 1977\text{-}80$$

7. AFRICA

$$D_A^{st} = \underset{(5.21)}{17.1912}E_A - \underset{(-4.52)}{51.0847}(P_A^{st}/PS_A) + \underset{(4.95)}{3763.68}$$

$$R^2 = 0.75; \quad DW = 1.39; \quad n = 1964\text{-}81$$

**From Adams, 1984. Estimates in brackets are standard error values.

APPENDIX 1b - Demand Equations* for Tropical Hardwood Plywood

1. PHILIPPINES

$$D_P^{pt} = \underset{(2.92)}{3.8965}E_{2P} - \underset{(-4.84)}{1.3052}(P_P^{pt}/PS_P) + \underset{(3.75)}{602.13} - \underset{(-2.92)}{231.75}U_{2P}$$

$R^2 = 0.84$; DW = 1.21; n = 1964-81

2. INDONESIA-MALAYSIA

$$D_I^{pt} = \underset{(5.15)}{4.5614}E_I - \underset{(1.63)}{0.58002}\ (P_I^{pt}/PS_I) + \underset{(0.89)}{147.2006}$$

$R^2 = 0.86$; DW = 1.59; n = 1964-81

3. ASIAN ENTREPOT

$$D_N^{pt} = \underset{(5.32)}{14.614}E_N - \underset{(-2.72)}{1.4825}(P_N^{pt}/PS_N) + \underset{(1.86)}{467.855}$$

$R^2 = 0.68$; DW = 1.54; n = 1964-81

4. JAPAN

$$D_J^{pt} = \underset{(2.00)}{36.006}E_J - \underset{(-1.57)}{8.2997}(P_J^{pt}/PS_J) + \underset{(14.46)}{6343.15} + \underset{(5.38)}{1546.3}U_{2J}$$

$R^2 = 0.82$; DW = 2.54; n = 1970-81

5. EUROPE

$$D_E^{pt} = \underset{(4.96)}{12.82236}E_E - \underset{(-1.96)}{2.4353}(P_E^{pt}/PS_E) + \underset{(1.35)}{926.24} + \underset{(3.22)}{521.0}U_{2E}$$

$R^2 = 0.80$; DW = 1.46; n = 1966-80

6. U.S.A.

$$D_U^{pt} = \underset{(2.11)}{7.67024}E_U - \underset{(-4.56)}{8.48094}(P_U^{pt}/PS_U) + \underset{(6.47)}{3484.62}$$

$R^2 = 0.59$; DW = 1.09; n = 1964-81

Figures in parentheses below coefficients are "t" statistics.

*See Appendix 2 for definition of variables.

7. AFRICA

$$D_A^{pt} = \underset{(4.22)}{1.4147}E_A - \underset{(-2.29)}{1.0935}(P_A^{pt}/PS_A) + \underset{(3.00)}{220.39}$$

$R^2 = 0.63$; $DW = 1.49$; $n = 1966\text{–}79$

APPENDIX 1c - Supply Equations* for Tropical Hardwood Sawnwood

1. PHILIPPINES

$$S_P^{st} = \underset{(3.94)}{646.36} + \underset{(2.34)}{4.0112} P_P^{st} - 4.0569 P_P^{LT} * M_P^{st}$$

$R^2 = 0.43$; DW = 2.14; n = 1966-81

2. INDONESIA-MALAYSIA

$$S_I^{st} = \underset{(6.44)}{3123.59} + \underset{(3.97)}{19.4} P_I^{st} - 19.272 P_I^{LT} * M_I^{st}$$

$R^2 = 0.50$; DW = 0.77; n = 1964-81

3. ASIAN ENTREPOTS

$$S_N^{st} = \underset{(7.05)}{1063.78} + \underset{(1.64)}{2.1903} P_N^{st} - 2.1980 P_N^{LT} * M_N^{st}$$

$R^2 = 0.24$; DW = 0.87; n = 1964-81

4. JAPAN

$$S_J^{st} = 57.067 (P_J^{st} - P_J^{LT} * M_J^{st})$$

($R^2 = 0.23$)
n=1964-81

5. EUROPE

$$S_E^{st} = \underset{(6.50)}{2312.882} + \underset{(3.38)}{4.4353} P_E^{st} - 4.1046 P_E^{LT} * M_E^{st}$$

$R^2 = 0.51$; DW=3.24; n= 1966-80

6. AFRICA

$$S_A^{st} = \underset{(3.70)}{1190.9545} + \underset{(6.93)}{10.004} P_A^{st} - 9.9898 P_A^{LT} * M_A^{st}$$

$R^2 = 0.53$; DW = 0.91; n = 1966-79

Figures in parentheses below coefficients are "t" statistics.

*See Appendix 2 for definition of variables.

APPENDIX 1d - Supply Equations* for Tropical Hardwood Plywood

1. PHILIPPINES

$$S_p^{pt} = \underset{(2.33)}{323.7465} + \underset{(3.65)}{4.6381}\,(P_p^{pt} - P_p^{LT}{*}M_p^{pt}) - \underset{(-2.26)}{293.48}U_{3p}$$

$R^2 = 0.55$; DW = 1.09; n = 1964-81

2. INDONESIA-MALAYSIA

$$S_I^{pt} = \underset{(-0.68)}{137.90} + \underset{(3.26)}{3.3524}P_I^{pt} - 3.3764P_I^{LT}{*}M_I^{pt}$$

$R^2 = 0.52$; DW = 1.48; n = 1970-81

3. ASIAN ENTREPOTS

$$S_N^{pt} = \underset{(0.74)}{659.78} + \underset{(2.61)}{11.3372}P_N^{pt} - 11.41305P_N^{LT}{*}M_N^{pt}$$

$R^2 = 0.30$; DW = 0.54; n = 1964-81

4. JAPAN

$$S_J^{pt} = \underset{(2.92)}{2635.54} + \underset{(4.29)}{45.8122}\,(P_J^{pt} - P_J^{LT}{*}M_J^{pt})$$

$R^2 = 0.54$; DW = 1.18; n = 1964-81

5. EUROPE

$$S_E^{pt} = 15.3691\,(P^{pt} - P_E^{LT}{*}M_E^{pt}) \qquad (R^2 = 0.25)\ n=1966-80$$

6. AFRICA

$$S_A^{pt} = \underset{(4.11)}{64.922} + \underset{(7.23)}{0.42835}P_A^{pt} - 0.42034P_A^{LT}{*}M_A^{pt}$$

$R^2 = 0.77$; DW = 0.53; n = 1964-81

Figures in parentheses below coefficients are "t" statistics.

*See Appendix 2 for definition of variables.

APPENDIX 1e - Supply Equations* for Tropical Logs

1. PHILIPPINES

(All attempts to estimate a normally-behaved supply function failed).

2. INDONESIA-MALAYSIA

$$S_I^{LT} = \underset{(4.93)}{20941.43} + \underset{(4.46)}{451.5} P_I^{LT}$$

$R^2 = 0.55$; DW = 0.41; n = 1964-81

3. AFRICA

$$S_A^{LT} = \underset{(15.11)}{10881.88} + \underset{(6.47)}{68.4484} P_A^{LT}$$

$R^2 = 0.72$; DW = 0.59; n = 1964-81

Figures in parentheses below coefficients are "t" statistics.

*See Appendix 2 for definition of variables

APPENDIX 2

DEFINITION OF VARIABLES

APPENDIX 2 - Definition of Variables

Legend to Abbreviations used:

a.d.c.	=	apparent domestic consumption
e.d.c.	=	estimated domestic consumption
RMM	=	raw material equivalent
THWP	=	tropical hardwood plywood
THWS	=	tropical hardwood sawnwood

D_A^{st} - apparent domestic consumption of tropical hardwood sawn-wood of Africa

D_E^{st} - estimated domestic consumption of THWS in Europe

D_E^{sn} - e.d.c. of non-coniferous sawnwood in Europr

D_I^{st} - a.d.c. of THWS in Indonesia-Malaysia

D_J^{st} - e.d.c. of THWS in Japan

D_N^{st} - e.d.c. of THWS in the Asian entrepots

D_P^{st} - a.d.c. of THWS in Philippines

D_U^{st} - e.d.c. of THWS in USA

D_A^{pt} - a.d.c. of tropical hardwood plywood in Africa

D_E^{pt} - e.d.c. of THWP in Europe

D_I^{pt} - a.d.c. of THWP in Indonesia-Malaysia

D_N^{pt}, D_J^{pt} -e.d.c. of THWP in the Asian entrepots and Japan, resp.

D_P^{pt} - a.d.c. of THWP in the Philippines

D_U^{pt} - e.d.c. of THWP in USA

E_A - All-Africa GDP Index (1970-1.0)

E_E - All-Europe Index of industrial production, 1970-100

E_I - Indonesia-Malaysia real GNP in constant 1980 US$

E_J - Japan real GNP in constant 1980 US$

E_N - Real GNP in constant 1980 US$; Korea & Singapore

E_{1p} - Philippines GNP in constant 1980 Phil. pesos

E_{2p} - Philippine construction index, 1980=100

E_U - US real GNP index, 1980=100

M_A^{st} - raw material multiplier for sawnwood in Africa = 1.8

M_E^{st} - RMM for THWS in Europe = 1.69

M_I^{st} - RMM for THWS in Malaysia-Indonesia = 1.75

M_J^{st} - RMM for THWS in Japan = 1.67

M_N^{st} - RMM for THWS in the Asian entrepots = 1.67

M_p^{st} - RMM for THWS in Philippines

M_A^{pt} - RMM for THWP in Africa = 2.5

M_E^{pt} - RMM for THWP in Europe = 2.27

M_I^{pt} - RMM for THWP and veneer in Indonesia-Malaysia

M_J^{pt} - RMM for THWP in Japan = 2.27

M_N^{pt} - RMM for THWP in the Asian entrepots = 2.27

M_P^{pt} - RMM for THWP and veneer in the Philippines = 2.2

P_A^{LT} - average f.o.b. export price of non-coniferous (NC) logs in Africa

P_E^{LT} - average c.i.f. import price of African logs in Europe

P_I^{LT} - average f.o.b. export price of HW logs from Indonesia- and Malaysia

P_J^{LT} - average c.i.f. import price of Southeast Asian logs

P_N^{LT} - average c.i.f. import price of SEA logs in the Asian entrepots

P_P^{LT} - average f.o.b. export price of Philippines HW logs

S_P^{st}, S_P^{pt} - production of THWS, THWP in Philippines

U_{IE} - dummy variable for European THWS demand (=1 for 1972, 1974, 1975; = 0 otherwise)

U_{2E} - dummy variable for European THWP demand (=1 for 1973; = 0 elsewhere)

U_{1J} - dummy variable for Japan THWS demand (=1 for 1977, 1978; = 0 elsewhere)

U_{2J} - dummy variable for Japan THWP demand (=1 for 1973, 74 = 0 otherwise)

U_N - dummy variable for THWS demand in the entrepots (=1 for 1973, 1974, 1980 = 0 otherwise)

U_{1P} - dummy variable for THWS demand in Philippines (=1 for 1971, 1973, 1979-81 = 0 otherwise)

U_{2P} - dummy variable for THWP demand in Philippines (=1 for 1969, 1974, 1975; = 0 otherwise)

U_{3P} - dummy variable for THWP supply in Philippines (=1 for 1969, 1974, 1975; = 0 otherwise)

APPENDIX 3

SOURCES OF DATA

APPENDIX 3 - Sources of Data

Data	Source Reference
Lumber prices	1,2,3,11,17,18
Plywood Prices	1,2,3,11,17,18
Log Prices	1,2,3,11,17,18
Consumption Figures	1,3,5,6,8,9,11
Production Figures	1,3,11,15,16
Price Deflators	5,7,8
Aggregate Indicators	7,8,9,12,13,14
Recovery Rates	4
Trade Flows	1,3,10,11
Freight Costs	5,10,15

Sources of Data

(1) FAO. Yearbook of Forest Products (selected years,1964 to 81)

(2) FAO. Forest Products Prices (1963-1982)

(3) UN/ECE. Timber Bulletin for Europe. (selected issues)

(4) UN/ECE. Timber Bulletin for Europe Supplements

(5) Takeuchi (1974, 1982)

(6) Radcliffe (1980)

(7) IMF. International Financial Statistics (selected issues)

(8) FAO. Monthly Bulletin of Statistics (1964-1983)

(9) OECD. Country Surveys (selected countries)

(10) U.S. Bureau of the Census. US Imports Schedule C

(11) Philippine Forestry Statistics (1976, 1980, 1981)

(12) Philippine Economic Indicators (1970, 1980)

(13) International Economic Indicators. (OECD)

(14) ASEAN Business Profile (1976)

(15) World Bank. Tropical Hardwood Handbook (1984)

(16) World Bank, Philippines: Industrial Development Strategy (1983)

(17) Sibal (1978)

(18) Tumaneng (1976)