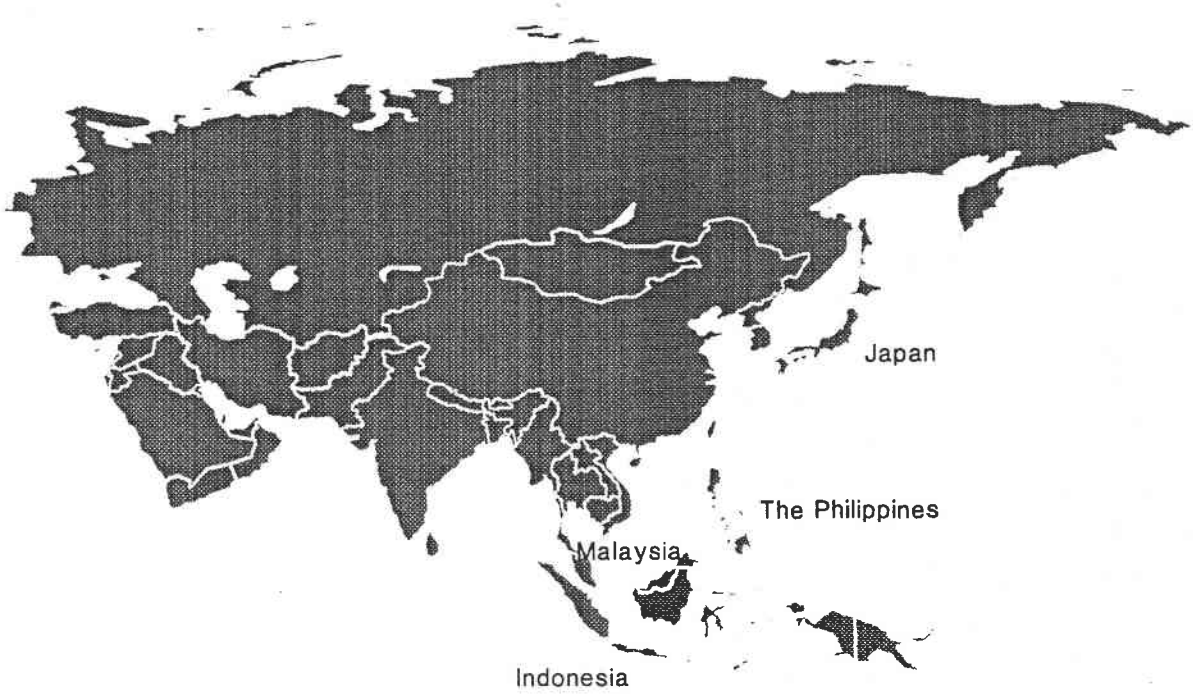
The Relationships Between Japanese Official Development Assistance and Tropical Timber Harvest Levels in Three Southeast Asian Countries



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AN ABSTRACT OF THE THESIS OF

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Title: The Relationship Between Japanese Official Development Assistance and Tropical Timber Harvest Levels in Three Southeast Asian Countries.

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Japan is the biggest importer of tropical logs in the world, and most of them are from Southeast Asia. It is also a major offerer of Official Development Assistance (ODA) to this area. The purpose of this thesis is to analyze the relationship between Japanese bilateral ODA to three Southeast Asian countries (Indonesia, the Philippines, and Malaysia) and tropical timber harvest levels in these countries. Two different methods are applied: econometric timber market model analysis and the Granger causality test.

Timber market model analysis shows a significant correlation between Japanese bilateral ODA and timber harvest levels in Indonesia and in Malaysia. It also shows a significant correlation between timber harvest levels in

Malaysia and the number of new housing construction starts in Japan. There is no significant relationship for the Philippines.

The Granger causality test shows clear evidence of causality from Japanese housing construction to timber harvest levels in Indonesia, and also to Japanese bilateral ODA to Indonesia. It shows evidence of causality from timber harvest levels in Malaysia to Japanese bilateral ODA to Malaysia, too. There are no causal effects among timber harvest levels in the Philippines, Japanese bilateral ODA to the Philippines, and Japanese housing construction.

All of the results can be explained in a reasonable manner by considering political, economic, and forestry situations of the three Southeast Asian countries and Japan.

The Relationship Between Japanese Official Development Assistance and Tropical Timber Harvest Levels in Three Southeast Asian Countries

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CHAPTER I : INTRODUCTION

I-1 TROPICAL DEFORESTATION

Tropical deforestation is a controversial issue in the world today[1]. It can result in serious problems such as soil erosion, loss of soil nutrients, decrease in water holding capacity, water sedimentation, microclimatic change, and extinction of species. It is also related to other issues such as global warming, population problems, and poverty in developing countries.

Tropical deforestation occurs in many places at the same time, but for different reasons. According to the World Resource Institute (WRI) (1990), there are three direct causes of tropical deforestation:

(1) Permanent conversion of forest to agricultural land.

(2) Commercial logging.

(3) The demand for fuelwood, fodder, and other forest products (ibid.,pp.106-107).

Rangeland conversion is the main reason for

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[1]For example, Palo (1987), Malingreau and Tucker (1988), Fearnside (1989), Rudel (1989), and World Resource Institute (WRI) (1990) argued this issue.

deforestation in South and Central America (Myers,1984; Browder,1988; Miller,1990). Demand for fuelwood is one of the largest causes of deforestation in many regions in South Asia and Africa (FAO,1982; Eckholm et al.,1984; Brown et al.,1988). Commercial timber harvest has been a major cause of deforestation of tropical forests in Southeast Asia as well as shifting cultivation (Caufield,1984; Brown et al.,1988). Reforestation practices have rarely been employed, and illegal loggers or slash-and-burn cultivators clear the forest after licensed logging (Gillis,1988a; Nectoux and Kuroda,1989a).

Efforts have been made to reduce tropical deforestation. The Tropical Forestry Action Plan prepared by the Food and Agriculture Organization of the United Nations (FAO) is still continuing in many countries (FAO,1985; FAO et al.,1987). The International Tropical Timber Organization (ITTO) is trying to build sustainable management strategies for the tropical timber industry (ITTO,1988). Non-governmental organizations (NGOs) are actively fighting the tropical deforestation in many parts of the world (de Silva et al.,1989; Patterson, 1990). People are eager to escape from the crisis of tropical deforestation, but unfortunately the rate of deforestation has not yet been reduced.

Governments of developing countries may think that industrialization is the best way to develop their countries. Those countries try to increase their export of primary

products, which have been historically their main exports, to get money and improve domestic industrialization at the same time. People, as well as the governments, of those countries need money to survive in the market economy, but it is very difficult for them to earn enough money. Structurally, prices of primary products and raw materials are uncertain, so the third world countries are always struggling to capture foreign exchange. The abundant harvest of cash crops may cause international prices to fall, and foreign food aid sometimes damages domestic agriculture.

Tropical deforestation is an aspect of a complex politico-economic problem between developed countries and developing countries, which is frequently referred to as the North-South problem. Therefore, we may have to solve this big problem in order to solve the tropical deforestation problem (Ross and Donovan,1986; Brown et al.,1990). Financial and technical support by developed countries and international agencies might be necessary in most developing countries. However, it should be carefully planned and be people oriented. Environmentally sound development, or sustainable development, is a key to this problem (Harvard Institute for International Development (HIID),1988; Dixon and Fallon,1989).

I-2 FOREST INDUSTRY IN SOUTHEAST ASIAN COUNTRIES

In some Southeast Asian countries, the forest industry

has been playing a big role in their governmental revenues for a long time[2]. These countries have good resources in their natural forests, while natural forests have disappeared in most of the developed countries. Southeast Asian countries used to have many commercially valuable trees and enough labor, but less capital and infrastructure.

To use foreign money for increasing their productivity was an easy solution, and it would benefit both developing and developed countries. Private firms in developed countries invested in the forestry sector in these countries[3], and governments of developed countries supported developing countries to build social and economic infrastructures by Official Development Assistance (ODA). In this way, Southeast Asian countries have enlarged their forestry-related industry. Malaysia is the biggest exporter of tropical logs and Indonesia is the biggest exporter of plywood in the world today (FAO,1991).

However, their situation is by no means reassuring. The rate of deforestation is very high, and many Southeast Asian countries have expanded their deforested areas rapidly in the last few decades. Thailand became a net importer of timber because of decreases in domestic productive forests. The

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[2]Appendix D shows some examples.

[3]Nectoux and Kuroda (1989a) listed up Japanese companies who invested to forestry sector in Southeast Asian countries after the World War II.

Philippines, which was the largest exporter of tropical logs, will also be a net importer of timber in the near future (Myers,1984; Ishi,1988).

I-3 JAPAN'S RELATIONSHIP TO SOUTHEAST ASIA

Japan is the largest importer of logs in the world (Japan Forestry Association,1989). About one third of all the tropical timber traded is imported by Japan and almost all of it has been from Southeast Asian countries (Nectoux and Kuroda, 1989a).

Japan began to import tropical timber in 1910, but the volume traded was relatively light until 1960. It rapidly increased in 1960s and early 1970s with Japan's economic growth. To satisfy their expanding timber demand, many Japanese trading companies, most of which are large conglomerates, financed the forestry sector or built joint ventures in the Philippines, Indonesia, and Malaysia as mentioned above. Expansion of forestry sectors in these countries certainly was due in large part to Japanese capital.

With its economic growth, Japan increased foreign aid offerings as one of the more advanced countries. Japan now is the second biggest contributor in the Development Assistance Committee (DAC) of the Organization for Economic Co-operation

and Development (OECD)[4].

According to Morrison (1988), the Japanese government has been using two main strategies for its ODA:

(1) Create overseas markets for Japanese products.

(2) Maintain steady supplies of primary products for their economic growth (ibid.,p.439).

Rix (1980,p.269) also mentioned that "producers dominate the policy making process" in Japan[5].

For both of the purposes Morrison described, Asian countries, especially members of the Association of SouthEast Asian Nations (ASEAN)[6], are good targets. Human resources are ample and also there are enough natural resources in these countries. In 1970, almost all of the Japanese bilateral ODA was given to Asian countries. The proportion for Asia has been decreasing gradually, but it was still about 60% in 1990[7]. The Japanese government admits to this directing of ODA toward Asia (Ministry of Foreign Affairs,1991). Within

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[4]According to the Ministry of Foreign Affairs (1991), major contributors were as follows: United States (10.2 billion US dollars (B$)), Japan (9.1 B$), France (6.6 B$), West Germany (6.3 B$), and Italy (3.4 B$) in 1990.

[5]The project of the Asahan dam in Indonesia was a typical example of governmental co-operation with overseas projects of Japanese companies. A giant dam was built mainly for supplying electricity to the aluminum plant of a joint company between Indonesia and Japan, and 85% of the project's cost was from Japanese ODA. See Kitazawa (1990) for details.

[6]ASEAN is composed by six nations: Brunei, Indonesia, Malaysia, the Philippines, Singapore, and Thailand.

[7]See Figure I-2 for details.

the money budgeted for Asia, about one half of it has been given to ASEAN countries.

Another reason for the strong relationship between Japan and Asia is that Japanese ODA was begun as reparations and quasi-reparations after World War II (Masuda,1988). Many East and Southeast Asian countries were invaded or colonized by the Japanese imperial army before and during World War II. In this way, recipients of Japanese ODA have mainly been Asian countries since its beginning.

Much of Japanese ODA are loans as opposed to gifts, and its Grant Element (GE) is second lowest among 18 DAC countries in 1988/89[8] (Ministry of Foreign Affairs,1991). This suggests the Japanese government's strong tendency for promoting economic development in the Third World. The dominant usage of ODA for building economic infrastructures supports this idea.

Because the Japanese government will not do any assistance for military purposes, building closer economic relationship with ASEAN countries is the best way to establish political stability in this region. The Japanese government likes to use the words "international division of aid labor" to explain this situation (Rix,1980).

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[8]Japanese GE was 77.6%. Percentage of gift in Japanese ODA was 43.2% and it was the lowest in the DAC countries. Those of the United States were 97.5% and 92.6% respectively in the same period.

I-4 OBJECTIVE OF RESEARCH

In 1987, a problem about tropical timber harvest in East Malaysia was discussed in National Diet of Japan (1987a,b). Many indigenous tribal people made blockades and interfered with the traffic of logging trucks on a road in the deep mountainous area in Limbang province of the State of Sarawak[9]. Those people had depended strongly on the rainforest for their livelihood, but were suffering from intensive logging activities in their habitat after the arrival of the logging company. This issue has frequently appeared in the media from a human rights point of view[10]. However, the controversial point at the Japanese Diet was that the road had been built by a joint company[11] of a Japanese trading company using Japanese bilateral ODA.

The same kind of use of ODA for forestry in Papua New Guinea has been recently in controversy (The Japan Times Weekly International Edition, 1991). Some environmental

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[9]Sarawak is a state located in the northwest of Borneo, and composes East Malaysia with the other state, Sabah. All of the logs exported from Malaysia are only from these two states, because log export is prohibited in West Malaysia.

[10]For example, see Sahabat Alan Malaysia (1987) and Aspinall (1990).

[11]According to Nectoux and Kuroda (1989b, appendix p.13), this was a logging and processing company named Limbang Trading Sdn. Bhd. It was a joint company of C Itoh, which was one of the largest trading companies in Japan, and Mr. James Wong, the Minister of Natural Resources of Sarawak. Soon after the scandal, C Itoh withdrew from Sarawak and repaid the loan, which was only 0.75% of annual interest, to Japanese government.

problems were incurred by the logging activity of a Japanese company which had received Japanese ODA for constructing logging facilities.

These issues show a problem around the management of ODA for the Japanese government. It is also pointed out by critics internally and externally to Japan that inefficient organization and self-oriented decision making dominate the Japanese ODA[12].

Thinking about the large impact of Japanese bilateral ODA for Asian countries headed by Japanese economic strategy, Japanese dependence on tropical timber from Southeast Asia, and spreading deforestation in this region, the fundamental research question is:

"Are there any relationships between Japanese ODA and tropical timber harvest levels in Southeast Asian countries?"

This is the main topic of this paper.

If it is possible, the question would be:

"Are there any relationships between Japanese ODA and tropical deforestation?"

However, it is extremely difficult to get the precise information of sequential data of deforestation in the long term.

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[12]Rix (1980) pp.14-15, Inoguchi (1988) p.24, and Nectoux and Kuroda (1989a) p.90, criticized Japanese ODA policy and/or its decision making system.

The meaning of my first question and second one is different, but I do not discuss the relationship between deforestation and harvest here. I suppose that timber harvest is strongly related to the deforestation in tropical Southeast Asia[13], but I should note that it is out of the range of this paper to analyze it. The first question itself is interesting and important to study for the future of Japanese ODA policy and Southeast Asian countries' resource management.

I-5 SCOPE OF RESEARCH

The countries I chose for this study are three of ASEAN countries : Indonesia, the Philippines, and Malaysia. These countries have been deeply tied to Japan in terms of timber trade and ODA flow.

In order to protect the domestic timber processing industry, the Japanese government has used relatively high trade barriers for value added timber products such as sawn timber and plywood (Australian Bureau of Agricultural and Resource Economics,1988). Therefore, most of their import of tropical timber has been raw logs. By the continuous pressure from countries in the General Agreement on Tariffs and Trade (GATT), Japan lowered the tariff rate for timber products,

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[13]For example, Hong (1989) argued deforestation in Malaysia with using harvest volume. See pp.165-178 of her book for details.

but still in 1988, more than 70% of imported tropical timber was logs (Nectoux and Kuroda,1989).

Figure I-1 shows the trend in tropical log imports by Japan from 1965 to 1987. Almost all of imported logs have been from the Philippines, Indonesia, and Malaysia. Recently, most logs are from Malaysia because the Philippines and Indonesia have banned the export of logs[14]. Indonesia exports large amounts of plywood to Japan, while the Philippines exports few timber products to Japan today. Japan is increasing its import of tropical logs from Papua New Guinea, but historically this trade has been insignificant.

By giving and receiving ODA, strong relationships developed between Japan and these three countries. Figure I-2 shows the distribution of Japanese bilateral ODA in 1970, 1980, and 1990. Each of these three countries, especially Indonesia, seems to be in a special position in Japanese foreign policy[15]. One reason why Japan strongly supports Indonesia's Suharto administration is for the security and stability of this relatively big country, which had a history

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[14]The Philippines prohibited to export raw logs in 1976, but illegal export continued after the regulation. Indonesia completed log export ban in 1985.

[15]The fact that Indonesia is one of the Organization of Petroleum Exporting Countries (OPEC) is important. In addition, it is the most populous but poorest country in ASEAN. See Ministry of Foreign Affairs (1991) for more information.

of communist activity in Sukarno era[16]. Geographical location of these three countries is also important: they all are on the way from the Middle East to Japan. This places them between Japan and its major source of oil.

On the other hand, we can easily understand the impact of Japanese ODA on these three countries. Figure I-3 shows the total ODA receipt and its sources for each of these three countries in 1989. Obviously, Japanese bilateral ODA plays a significant role in each.

To analyze the relationship between Japanese bilateral ODA and tropical timber harvest levels in three Southeast Asian countries, I use econometric methods.

First, I make a model of the tropical hardwood timber[17] markets in each of the three countries. The key point of this analysis is the hypothesis that the Japanese bilateral ODA is pertinent in both the supply and the demand for logs. By using the Ordinary Least Square (OLS) multiple regression analysis method, I derived reduced form functions of log production for three countries separately. Results of this analysis will show whether or not a significant correlation

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[16]Sukarno, who was the first president of Indonesia, also had had a strong connection to Japanese politicians since World War II. For example, see Nishihara (1976).

[17]Almost all of the tropical timber harvested for industrial use in Southeast Asian countries are hardwood species. So, in this paper, I use "tropical timber" as "tropical hardwood timber".

exists between Japanese bilateral ODA and log production volume.

Second, I try to find the direction of causal effects between ODA and log production. If the Japanese bilateral ODA simply plays an economic role to facilitate private investments, ODA would cause the increase of log production. If, however, the Japanese government uses ODA for more political means, i.e., to reward trading partners, then log production may cause the influx of ODA. I apply the Granger causality test, which is one of the popular causality tests in econometrics (Geweke et al.1983), for this analysis.

Details of both model testing methods will be described in chapter III.

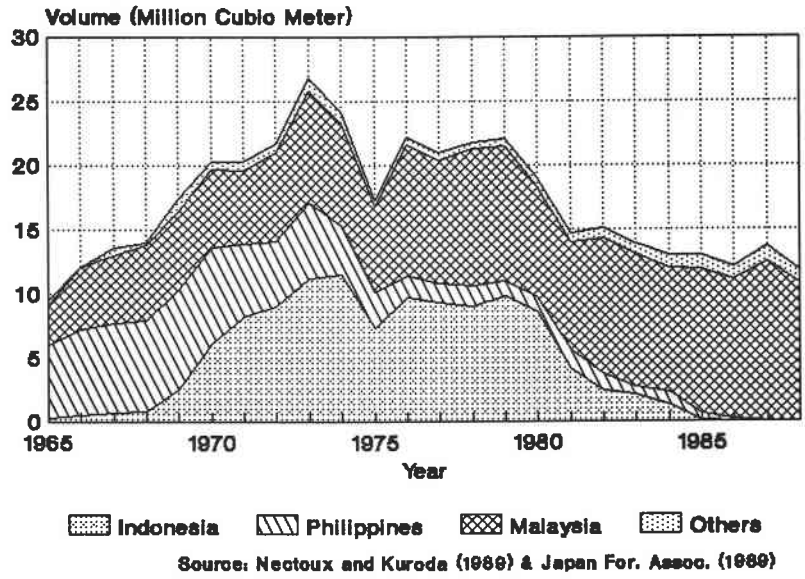


Figure I-1. The trend in tropical log imports by Japan from 1965 to 1988.

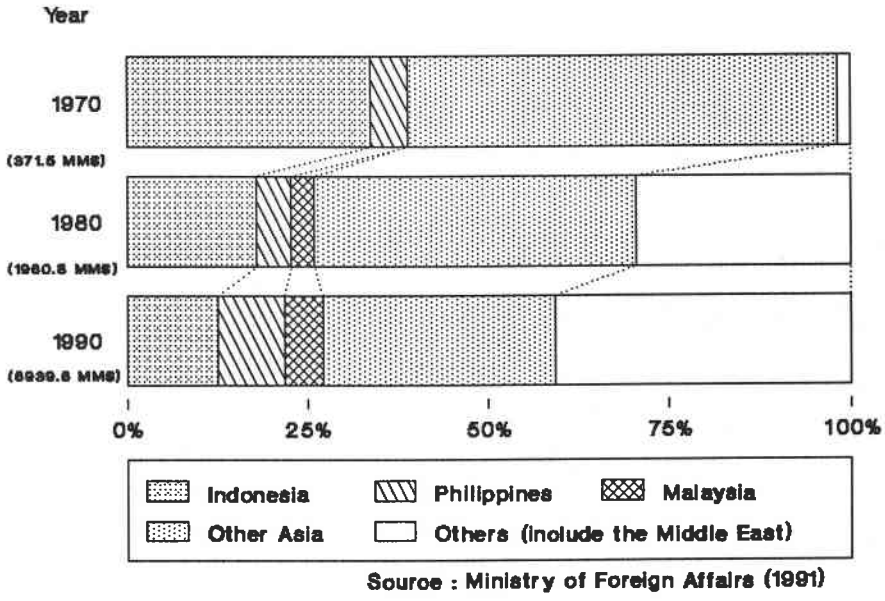
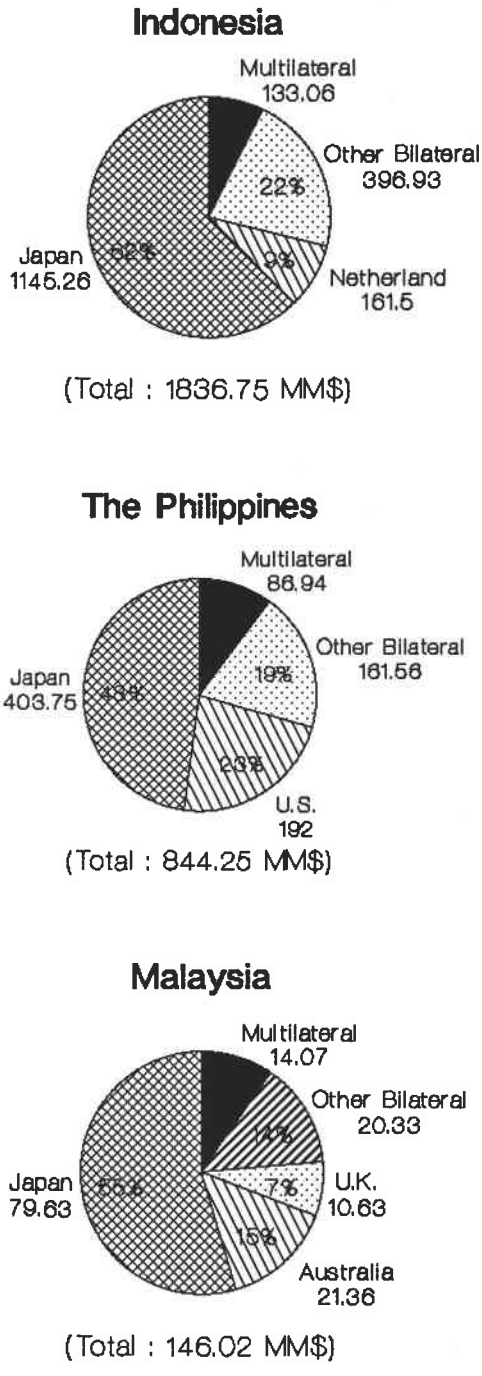


Figure I-2. Distribution of Japanese bilateral ODA in 1970, 1980, and 1990 based on net disbursement.



Source : Ministry of Foreign Affairs (1991)

Figure I-3. Total ODA receipt and its supply sources for Indonesia, the Philippines, and Malaysia in 1989.

CHAPTER II : BACKGROUND

II-1 SOUTHEAST ASIAN FORESTRY AND JAPAN

Nectoux and Kuroda (1989a) did a painstaking work about the trade of tropical timber between Japan and Southeast Asian countries. They analyzed the demand of the tropical timber, trade system, and the timber processing industry of Japan, and also pointed out some problems including logging methods, concessions, and environmental degradation of forest land in Southeast Asian countries.

They found four key reasons why Japan had been the world's major tropical log importer:

(1) The considerable, and "often excessive" (ibid.,p.5) timber and paper requirements of the booming Japanese economy.

(2) The high cost of domestically grown timber.

(3) The availability of cheap, high quality timber from Southeast Asia.

(4) The fact that the import of tropical hardwood logs is largely organized by the principal general trading houses.

In conclusion, they requested some changes of tropical timber trading mainly because of environmental concerns, and proposed several alternatives. For Japanese foreign aid policy, they recommended implementation of the Environment Impact Assessment (EIA) procedure, and playing a positive

role in determining the policy of international institutions.

According to Gillis (1988a,b), Boado (1988), and Repetto (1988), the governments of Indonesia, the Philippines, and Malaysia did not have enough capability to manage forest resources, and they misused their forest resources. These researchers felt the necessity for a long term planning horizon in forest policy.

The ITTO Mission to Sarawak had similar results. It stated that the rate of logging there was far from sustainable, and recommended reducing the rate of timber harvesting and also the total area of logging[18].

Corruption in governments might be a fundamental problem in many developing countries including our three Southeast Asian tropical timber producing countries. Hancock (1989,pp.174-183) reported embezzlements of ODA money in Indonesia, the Philippines and many other developing countries. Palo (1987) mentioned that even in the UK and US, corruption affected deforestation, so apparently it did in developing countries. To make matters worse, "in the reports by the various organizations of the UN the existence and causal effects of corruption cannot be studied or mentioned for political reasons" (ibid.,p.71). To not study this problem might be an another big problem.

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[18]See Asia Pacific Forest Industries (Dec.1990), and Wodsworth (1991) for details of the recommendations.

II-2 TIMBER MARKET MODELS

Vincent (1987) made market models of tropical timber trade between Japan and Indonesia, the Philippines, and Malaysia. Based on linear demand and supply curves, he analyzed effects of log export embargoes and changes in exchange rates in each of these tropical timber producing countries. An interesting point of his results was that log export embargoes will profit both domestic producers and consumers of sawn timber and plywood, while they will not contribute to raising the total surplus of the country.

McKillop (1973) constructed econometric models of softwood trade between Japan and North America. He concluded that there were two important features of Japanese demand for North American timber:

(1) The level of housing construction in Japan was very influential to their timber demand.

(2) Japanese demand for North American timber was "totally inelastic" (ibid.,p.63).

Because a major portion of the final consumption of log in Japan was housing construction, his results seemed reasonable.

The study of the hardwood market model by Luppold (1982) was clear and well organized. He built the demand, supply, and price equations of OLS by using a 19-year data series. The method and procedure he did was a good example of an

econometric model of the timber market[19].

II-3 GRANGER CAUSALITY TESTS

"Granger-causality" is an econometric or statistical term, and is not the same as the word "causality" in our common language. A "Granger-causal" relationship does not necessarily mean a physical cause-effect relationship[20]. Instead, it means that one event precedes another in time.

There are many studies of causality which apply the Granger causality tests, but I have not seen any of them which are related to the tropical timber market.

A typical, but almost trivial example of the Granger causality test was Thurman and Fisher (1988). They tested the causality between chickens and eggs, and got unidirectional causality from eggs to chickens.

Another nice example was Hamilton (1983). He tested the causality between oil price and other major macroeconomic variables, and found some evidence of causality from oil price to national output[21].

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[19]Brännlund et al.(1985) was also a good example of econometric timber market analysis.

[20]See Hicks (1979) pp.87-102, and Brown (1991) pp.335-343.

[21]Sims (1972) was an another good example. The original work of Granger (1969) explained the statistical theory of the test well.

CHAPTER III : MODELS

III-1 TROPICAL TIMBER MARKET MODEL

In the three Southeast Asian Countries, most of the forest land belongs to the government. Trees are harvested by private logging companies which have licenses for harvesting. Large portions of the harvested timber are exported, and others are consumed domestically. Japanese bilateral ODA is mainly used for constructing economic and social infrastructures, and some is directly aimed at the forest sector in the country. Considering the above situation, I specified the supply and the demand functions as follows:

Supply Function

The quantity of the tropical hardwood timber supply[22] is expressed as a function of log price, lagged quantity supplied, amount of Japanese bilateral ODA to the country, and cost of timber production. All the data are based on yearly observation.

The price of the product is a basic variable of the supply function in economic theory. Although the price of timber is not determined uniquely, it is reasonable to use the average export price of logs as the price of timber harvested.

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[22]This quantity of supply is represented by the industrial roundwood production volume.

Lagged quantity supplied is included as a dynamic adjustment variable. The supply function of tropical hardwood timber is assumed to have distributed lag in it.

Japanese bilateral ODA is included in the supply function as a contributor to forest sector.

Input cost is another basic variable of the supply function. I choose the Consumer Price Index (CPI) as the indicator of input cost of timber production in lieu of wage rate.

The final form of the supply function that I specified is as follows:

$$Q_t^s = \alpha_0 + \alpha_1 P_t + \alpha_2 Q_{t-1}^s + \alpha_3 ODA_t + \alpha_4 CPI_t + \epsilon_t \qquad (3.1)$$

where

Q_t^s : Timber supply quantity in year t.

P_t : Log export price in year t.

Q_{t-1}^s : Timber supply quantity in year t-1.

ODA_t : Japanese bilateral ODA to the country in year t.

CPI_t : CPI of the country in year t.

Expected signs and units of variables in equation (3.1) are in Table III-1. The units of native currency in three Southeast Asian countries are as follows:

Indonesia : Rupiah

The Philippines : Pesos

Malaysia : Ringgit

Table III-1. Expected signs and units of variables in the supply function.

Variables	Expected Signs	Units[23]
P_t	Positive	Native currency / m^3 (Real 1985 value)
Q_{t-1}^s	No a priori expectations	M m^3
ODA_t	Positive	Native currency (Real 1985 value)
CPI_t	Negative	Index (1985 = 100)

Demand Function

Quantity of tropical hardwood timber demanded[24] is expressed as a function of log price, Japanese bilateral ODA, and the number of new housing construction starts in Japan.

The price of the product is also a basic variable of the demand function in economic theory. I use the average export price of logs, which is the same variable in the supply function.

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[23]In this paper, single "M" means one thousand of the unit. Therefore: M = 1000; MM = 1000,000; MMM = 1000,000,000.

[24]This quantity of demand was composed by demand for both domestic use and export.

Japanese bilateral ODA is included in the demand function because it stimulates the economy directly by constructing roads and ports, and indirectly by raising people's standard of living.

The number of new housing construction starts in Japan represents foreigners' requirement of Southeast Asian country's timber. Because Japan is the main importer of tropical hardwood timber, and housing construction is its major consumption of timber, it is appropriate to include the variable of the number of new housing construction starts in Japan in the demand function.

The final form of the demand function that I specified is as follows:

$$Q_t^d = \beta_0 + \beta_1 P_t + \beta_2 ODA_t + \beta_3 HCJ_t + \epsilon_t \qquad (3.2)$$

where

Q_t^d : Timber demand quantity in year t.

P_t : Log export price in year t.

ODA_t : Japanese bilateral ODA to the country in year t.

HCJ_t : Number of new housing construction starts in Japan in year t.

Expected signs and units of variables in equation (3.2) are in Table III-2.

Table III-2. Expected signs and units of variables in the demand function.

Variables	Expected Signs	Units
P_t	Negative	Native currency / m^3 (Real 1985 value)
ODA_t	Positive	Native currency (Real 1985 value)
HCJ_t	Positive	M Houses

Reduced Form Equation

To analyze the total effect of Japanese bilateral ODA on tropical timber harvest levels, the supply function and the demand function are combined by substituting P_t from one to the other.

$$Q_t^s = \alpha_0+\alpha_1 P_t+\alpha_2 Q_{t-1}^s+\alpha_3 ODA_t+\alpha_4 CPI_t+\epsilon_t \qquad (3.1)$$

$$Q_t^d = \beta_0+\beta_1 P_t+\beta_2 ODA_t+\beta_3 HCJ_t+\epsilon^*_t \qquad (3.2)$$

From equation (3.1),

$$P_t = -\frac{1}{\alpha_1}[\alpha_0+\alpha_2 Q_{t-1}^s+\alpha_3 ODA_t+\alpha_4 CPI_t+\epsilon_t-Q_t^s] \qquad (3.3)$$

By substituting equation (3.3) to (3.2), we get

$$Q_t^d = \beta_0 - \frac{\beta_1}{\alpha_1}[\alpha_0 + \alpha_2 Q_{t-1}^s + \alpha_3 ODA_t + \alpha_4 CPI_t + \epsilon_t - Q_t^s] + \beta_2 ODA_t + \beta_3 HCJ_t + \epsilon_t^* \quad (3.4)$$

or,

$$Q_t^d - \frac{\beta_1}{\alpha_1} Q_t^s = (\beta_0 - \frac{\alpha_0\beta_1}{\alpha_1}) - \frac{\alpha_2\beta_1}{\alpha_1} Q_{t-1}^s - (\frac{\alpha_3\beta_1}{\alpha_1} - \beta_2) ODA_t - \frac{\alpha_4\beta_1}{\alpha_1} CPI_t + \beta_3 HCJ_t - (\frac{\beta_1}{\alpha_1}\epsilon_t - \epsilon_t^*) \quad (3.5)$$

At equilibrium, the quantity of the supply should be the same as the quantity of the demand. Therefore,

$$Q_t^s = Q_t^d = Q_t \quad (3.6)$$

Then, we obtain the reduced form equation of the timber market as follows:

$$Q_t = (\frac{-\alpha_0\beta_1 + \alpha_1\beta_0}{\alpha_1 - \beta_1}) - (\frac{\alpha_2\beta_1}{\alpha_1 - \beta_1}) Q_{t-1} + (\frac{\alpha_1\beta_2 - \alpha_3\beta_1}{\alpha_1 - \beta_1}) ODA_t - (\frac{\alpha_4\beta_1}{\alpha_1 - \beta_1}) CPI_t + (\frac{\alpha_1\beta_3}{\alpha_1 - \beta_1}) HCJ_t - (\frac{\beta_1\epsilon_t - \alpha_1\epsilon_t^*}{\alpha_1 - \beta_1}) \quad (3.7)$$

For simplification, rewrite this equation using new coefficients.

$$Q_t = \gamma_0 + \gamma_1 Q_{t-1} + \gamma_2 ODA_t + \gamma_3 CPI_t + \gamma_4 HCJ_t + \epsilon_t^{**} \quad (3.8)$$

where

Q_t : Timber harvest quantity in year t.

Q_{t-1} : Timber harvest quantity in year t-1.

ODA_t : Japanese bilateral ODA to the country in

year t.

CPI_t : CPI of the country in year t.

HCJ_t : Number of new housing construction starts in Japan in year t.

Expected signs of variables in this reduced form equation (3.8) are in Table III-3.

Table III-3. Expected signs of variables in the reduced form timber harvest equation.

Variables	Expected Signs
Q_{t-1}	No a priori expectations
ODA_t	Positive
CPI_t	Negative
HCJ_t	Positive

The equation (3.8) is estimated in linear form for a 20-year period between 1970-89. Yearly observations for this period are chosen due to the reliability and the availability of data. Because it is not necessary for my purpose to analytically derive the supply and the demand functions separately, I have estimated the reduced form equation using OLS procedures. The political, social, economic, and forestry situations of Indonesia, the Philippines, and Malaysia are very different from each other, so I have analyzed the timber market of these three countries separately.

III-2 GRANGER CAUSALITY TEST MODEL

For testing Granger causality between two variables, say Q_t and ODA_t, we consider the equations with sum of the lagged variables. The basic idea of the Granger causality test is to determine whether lagged values of one variable play a significant role in explaining the other variable or not. The full model of the Granger causality test equations are as follows:

$$Q_t = \alpha_0 + \sum_{i=1}^{m} \alpha_i Q_{t-i} + \sum_{i=1}^{m} \beta_i ODA_{t-i} + \epsilon_t \qquad (3.9)$$

$$ODA_t = \gamma_0 + \sum_{i=1}^{m} \gamma_i ODA_{t-i} + \sum_{i=1}^{m} \delta_i Q_{t-i} + \epsilon^*_t \qquad (3.10)$$

where, m is an arbitrary number showing lag length, typically 1 to 4.

Next, we need the restricted model equations as follows:

$$Q_t = \alpha_0 + \sum_{i=1}^{m} \alpha_i Q_{t-i} + \epsilon_t \qquad (3.11)$$

$$ODA_t = \gamma_0 + \sum_{i=1}^{m} \gamma_i ODA_{t-i} + \epsilon^*_t \qquad (3.12)$$

The difference between equation (3.9) and (3.11) is the existence of lagged variables of ODA_t in equation (3.9). Therefore, examining the partial F-test between the full model (3.9) and the reduced model (3.11), we can test the hypothesis that the group of lagged ODA_t variables are significant for Q_t or not.

In summary, we test the following hypothesis,

$$H_0 : \beta_1 = \beta_2 = \cdots = \beta_m = 0$$
$$H_a : \beta_1 \neq 0, \beta_2 \neq 0, \cdots, or \ \beta_m \neq 0$$

by using the following F-statistic,

$$F_{m,N-2m-1} = \frac{(R_f^2 - R_r^2) / m}{(1 - R_f^2) / (N-2m-1)} \qquad (3.13)$$

where

R_f^2 : R-square of full model

R_r^2 : R-square of reduced model

N : Number of observations

m : Number of restrictions
(or the length of lag)

If $F > F^*$[25] then, reject H_0. This means the group of lagged ODA_t variables are significantly correlated with Q_t. In other words, it shows that ODA_t "Granger-causes" Q_t.

Equivalently, we can do the same procedure using equations (3.10) and (3.12). The only difference is the direction of causality between two variables. Then, we know whether Q_t "Granger-causes" ODA_t or not.

After testing causality from both directions, we can conclude the causal relationship between Q_t and ODA_t. In case ODA_t "causes" Q_t but Q_t does not "cause" ODA_t, or Q_t "causes"

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[25] F^* is the critical value of F-distribution at 5% significance level for the appropriate N and m.

ODA_t but ODA_t does not "cause" Q_t, it indicates unidirectional causality. In case ODA_t "causes" Q_t and Q_t also "causes" ODA_t, then we call the situation as a bidirectional causality. If there is no causality, the two variables are independent in terms of "Granger-causal" relationship.

By considering several different lag lengths, we can obtain more reliable evidence of the existence or absence of causal relationships between the two variables.

CHAPTER IV : DATA

IV-1 DATA SOURCES

The data used in the reduced form equation of tropical hardwood timber market is a 20-year set (1970-89) of five variables; Q_t, Q_{t-1}[26], ODA_t, CPI_t, and HCJ_t. In the Granger causality tests, the same 20-year data set (1970-89)[27] of three variables; Q_t, ODA_t, and HCJ_t; are used. Details of the variables and their sources are shown below.

Reliability of data is usually a problem in this kind of study. I tried to choose generally reliable data sources such as international organizations and Japanese governmental agencies. I do not use data directly from Southeast Asian countries.

Q: Timber harvest quantity

The data for this variable is roundwood production volume of hardwood from FAO's "Yearbook of Forestry Products 1989". It is consistent to get the data of timber harvest quantities of three countries from the same source, and data from FAO's "Yearbook" are one of the most reliable data for

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[26] Q_{t-1} is one year lagged variable of Q_t, therefore the data set of Q_{t-1} from 1970 to 1989 is the same as the data set of Q_t from 1969 to 1988.

[27] As shown in chapter III, Granger causality tests use lagged variables. Therefore, the number of the data set of each test is expressed as (20-m). Where, m is the length of the lagged year.

forestry of the developing countries.

P: Price of timber

The variable of the price of timber appears in both the supply and the demand function, but not in the reduced form equation. Therefore, I do not use this variable in any of my regression analyses. In appendix C, I show the trend in average roundwood export prices in three countries as a reference. These data are calculated from FAO's "Yearbook".

ODA: Japanese bilateral Official Development Assistance

Japanese bilateral ODA is composed of three parts. They are loans, gifts, and technical assistance. I use the sum of loans and gifts as Japanese bilateral ODA because of data availability. The value of ODA in each year is based on the exchange of official note values.

"Japan's Official Development Assistance: 1991 Annual Report" of the Ministry of Foreign Affairs is the primary data source for this variable. I have also used "The Present State and Problems of Economic Co-operation: 1991 Annual Report" of the Ministry of International Trade and Industry (MITI).

I converted the value of Japanese bilateral ODA in nominal Japanese yen to the real term of currency of each timber producing country. The reason is that it is the best way to show real purchasing power of Japanese ODA in the

country. The calculation for conversion is as follows:

$$ODA\,[\,Real\,X\,] = \frac{ODA\,[\,Nominal\,]}{e_{Yen-X}} * \frac{1}{\left(\frac{CPI_X}{100}\right)} \qquad (4\text{-}1)$$

where e_{Yen-X} is the exchange rate between Japanese yen and the currency of country X. CPI_X is the CPI of country X.

The data of the exchange rate is from "International Financial Statistics Yearbook 1989" of International Monetary Fund (IMF).

CPI: Consumer Price Index

I use this variable in lieu of wage rate of the timber industry because wage rate data are unavailable. It is reasonable to assume that the wage rate shifts in correspondence with levels of consumer prices. I got the data of CPI from "International Financial Statistics Yearbook 1989" of IMF. It takes 1985 as the base year.

HCJ: Number of new housing construction starts in Japan

This variable includes both the number of new construction starts of wooden houses and those of non-wooden houses. Traditionally, Japanese houses are made of wood, and people love the wooden touch in their homes. The construction

of concrete buildings is increasing rapidly in recent years, but people's preference for wood has not changed, and they still want to use plywood inside their concrete houses as well as their wooden houses.

Much of the lower quality tropical timber is used as concrete forming panels for construction. It is thus appropriate to get both of the number of wooden and non-wooden houses into this variable.

The data for new housing construction starts is from the "Monthly Statistics of Japan" series of the Statistic Bureau in Management Coordination Agency.

IV-2 DATA SETS

Complete data sets of the reduced form equation of tropical timber market in Indonesia, the Philippines, and Malaysia are in Table IV-1, IV-2, and IV-3, respectively. The same data sets of Q_t, ODA_t, and HCJ_t are also used for Granger causality tests of each country.

Table IV-1. Data Set for Indonesia.

Year	Q	ODA	CPI	HCJ
	----- ($M\ m^3$)	--------- (MMM Rupiah)	----- (1985 = 100)	---- (M Houses) ------
1969	8821	-	-	-
1970	12564	278.69	12.9	1476.0
1971	15614	644.00	13.4	1452.0
1972	18777	614.92	14.8	1800.0
1973	28200	1189.75	18.7	1905.1
1974	25172	324.15	26.3	1316.1
1975	17902	278.56	31.3	1356.3
1976	25351	258.39	37.5	1523.8
1977	24528	218.77	41.7	1508.3
1978	28865	440.22	45.1	1549.4
1979	27152	500.24	53.3	1493.0
1980	29898	331.26	62.9	1268.6
1981	25721	261.34	70.6	1151.7
1982	24883	232.34	77.3	1146.1
1983	27954	334.81	86.4	1136.8
1984	29490	360.60	95.5	1187.3
1985	26080	388.86	100.0	1236.1
1986	30026	631.40	105.8	1364.6
1987	38896	946.44	115.6	1674.3
1988	38940	2156.67	124.9	1684.6
1989	38982	1799.71	133.0	1662.6

Table IV-2. Data Set for the Philippines.

Year	Q	ODA	CPI	HCJ
	----- ($M\ m^3$)	--------- (MMM Pesos)	------ (1985 = 100)	---- (M Houses) ------
1969	12627	-	-	-
1970	12330	0.06	10.0	1476.0
1971	12348	3.53	12.2	1452.0
1972	12243	2.09	13.2	1800.0
1973	12541	2.52	15.4	1905.1
1974	9624	1.72	20.6	1316.1
1975	10560	1.64	22.0	1356.3
1976	11029	2.54	24.0	1523.8
1977	10447	3.07	26.4	1508.3
1978	9820	5.30	28.4	1549.4
1979	9286	0.44	33.3	1493.0
1980	8969	3.43	39.4	1268.6
1981	7763	3.86	44.6	1151.7
1982	7041	3.97	49.1	1146.1
1983	7107	6.36	54.0	1136.8
1984	6920	4.40	81.2	1187.3
1985	5702	2.45	100.0	1236.1
1986	5625	7.14	100.8	1364.6
1987	6354	17.90	104.6	1674.3
1988	6158	20.53	113.7	1684.6
1989	5378	16.17	125.8	1662.6

Table IV-3. Data Set for Malaysia.

Year	Q	ODA	CPI	HCJ
	----- ($M\ m^3$)	--------- (MM Ringgit)	------ (1985 = 100)	---- (M Houses) ------
1969	17636	-	-	-
1970	19691	0.00	45.0	1476.0
1971	19083	688.30	45.7	1452.0
1972	21774	0.00	47.1	1800.0
1973	25228	0.00	52.1	1905.1
1974	22918	484.78	61.2	1316.1
1975	20354	0.00	63.9	1356.3
1976	27664	7.84	65.6	1523.8
1977	28742	280.20	68.7	1508.3
1978	29625	321.05	72.1	1549.4
1979	29649	281.14	74.7	1493.0
1980	29061	253.81	79.7	1268.6
1981	31813	657.63	87.4	1151.7
1982	33894	22.05	92.5	1146.1
1983	33977	643.57	95.9	1136.8
1984	32284	208.71	99.7	1187.3
1985	29851	64.11	100.0	1236.1
1986	31092	205.49	100.7	1364.6
1987	36339	7.56	101.6	1674.3
1988	40222	1561.93	103.6	1684.6
1989	42268	1136.19	106.5	1662.6

CHAPTER V : RESULTS

V-1 TIMBER MARKET MODEL ANALYSIS

Indonesia

The estimated equation for the timber market in Indonesia is:

$$Q_t = \underset{(t)}{3937.0} + \underset{(0.71)}{0.3072}Q_{t-1} + \underset{(1.71)}{4.161}ODA_t + \underset{(2.42)^{**}}{131.31}CPI_t + \underset{(2.46)^{**}}{3.953}DUM85*HCJ_t \quad \underset{(1.53)}{}$$

where * : significant at 90% C.I.

** : significant at 95% C.I.

Adjusted R^2 is 0.7830, F-ratio is 18.14, and Durbin h statistic is -0.0749. Two variables (ODA_t and CPI_t) are significant at 95% Confidence Interval (C.I.), and two (Q_{t-1} and HCJ_t) are out of 90% C.I. All of the signs of coefficients are consistent with expectation except that of CPI_t.

CPI is the weighted average of the prices of the goods and services including wage rate. I used CPI_t as the wage rate of timber industry, but it likely capture many other factors. For example, CPI may represent the price of processed timber and wood products, then it will be positively related to the timber supply function. CPI may represent the living expense, and it will be negatively related to the timber demand function. It may also represent the household income of urban dwellers or price of substitution of logs, then, CPI is

expected to be positively related to the timber demand function. Thus CPI can represent other factors as well as the wage rate of timber industry in the reduced form equation. Therefore, the positive sign of the coefficient of CPI is acceptable, and overall performance of this regression is satisfactory.

The dummy variable, DUM85, takes the value 1 before 1985 and 0 otherwise. It is multiplied by HCJ_t to indicate the log export ban. The Indonesian government completed the log export ban until 1985, and a drastic change of export volume occurred in this year. Therefore, the impact of their log production on foreign demand is different before and after this year.

The p-value of the coefficient of ODA_t is 0.0288, and this implies that ODA_t correlates to Q_t. CPI_t also significantly correlates to Q_t, and its p-value is 0.0267.

Details of the model fitting results of OLS for this equation are in Table V-1, and the comparison of observed and predicted timber harvest levels of Indonesia is in Figure V-1.

The Philippines

The estimated equation for the timber market in the Philippines is:

$$\begin{array}{lccccc} Q_t = & 3749.9 & +0.6037Q_{t-1} & +105.30ODA_t & -29.82CPI_t & +0.4337DUM86*HCJ_t \\ (t) & (1.50) & (3.22)^{**} & (1.65) & (-2.00)^{*} & (0.55) \end{array}$$

where * : significant at 90% C.I.

** : significant at 95% C.I.

Adjusted R^2 is 0.9019, F-ratio is 44.69, and Durbin h statistic is 0.0089. Q_{t-1} is significant in 95% C.I., and CPI_t is significant in 90% C.I. ODA_t and HCJ_t are not significant. All of the signs of coefficients are consistent with expectation. Overall performance of this regression is satisfactory.

Dummy variable, DUM86, takes the value 1 before 1986 and 0 otherwise. It is multiplied by HCJ_t since the new government of the Philippines promoted a log export ban strongly from this year under Aquino's presidency, and the volume exported to Japan became almost zero after that[28]. However, the t-value of HCJ_t is not significant, and it appears that foreign demand represented by Japanese housing construction starts is not significantly correlated to the Philippines' log production.

ODA_t is also not significantly correlated to Q_t. The p-value of the coefficient of ODA_t is 0.1196.

Details of the model fitting result of OLS for this equation are in Table V-2, and the comparison of observed and predicted timber harvest levels of the Philippines is in

[28]The government of the Philippines prohibited log export in 1976, but they could not fully proceed the regulation. In appendix B, I show the trend of log export volume in three countries.

Figure V-2.

Malaysia

The estimated equation for the timber market in Malaysia is:

$$\begin{matrix} Q_t = & -22789 + & 0.0671Q_{t-1} & +2.5000DA_t & +351.2CPI_t & +12.45HCJ_t & +5174.1DUM85 \\ (t) & (-3.68)^{**} & (0.30) & (2.05)^{*} & (4.66)^{**} & (5.20)^{**} & (3.13)^{**} \end{matrix}$$

where * : significant at 90% C.I.

** : significant at 95% C.I.

Adjusted R^2 is 0.9378, F-ratio is 58.33, and Durbin h statistic is 0.0393. ODA_t is significant in 90% C.I. CPI_t and HCJ_t are significant in 95% C.I. Q_{t-1} is not significant. All of the signs of coefficients are consistent with expectation except that of CPI_t. However, the positive sign of the coefficient of CPI_t is acceptable by the same reason for the case of Indonesia. Overall performance of this regression is satisfactory.

Dummy variable, DUM85, takes the value 1 before 1985 and 0 otherwise. This dummy variable is introduced to remove the effect of a strong yen starting in 1985[29]. The timber market

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[29]An extraordinary appreciation of yen began in late September 1985, and a strong yen is still continuing in 1992. The main cause of it is international agreement of monetary policy to balance Japanese huge current account surplus. For example, OECD (1986) described about it as "Need for a strong yen" (ibid.,pp.47-54). A statement by Japanese government in IMF annual meeting in 1986 showed the response of the economy of

of Malaysia, which is the only major exporter of tropical logs to Japan, should be affected by the drastic change of exchange rate in Japanese yen.

The p-value of the coefficient of ODA_t is 0.0599, that of HCJ_t is 0.0001, and that of CPI_t is 0.0004. These variables significantly correlate to Q_t.

Details of the model fitting results of OLS for this equation are in Table V-3, and the comparison of observed and predicted timber harvest levels of Malaysia is in Figure V-3.

Japan to this "unprecedentedly fast change" (IMF,1986,p.39).

Table V-1. Model fitting results of the reduced form tropical hardwood timber market equation in Indonesia.

Variable	Coefficient	Std. error	t-stat.	p-value
CONSTANT	3937.041006	5557.858195	0.7084	0.4896
Q_{t-1}	0.307161	0.179894	1.7075	0.1083
ODA_t	4.161036	1.721357	2.4173	0.0288
CPI_t	131.310450	53.454548	2.4565	0.0267
$DUM85*HCJ_t$	3.953361	2.590054	1.5264	0.1477

R^2	:	0.828672
Adjusted R^2	:	0.782984
Standard error	:	3317.49
Durbin-Watson stat.	:	2.08727
Durbin h statistic	:	-0.0749
Observation number	:	20

Analysis of variance

Source	Sum of Square	DF	Mean Square	F-ratio	P-value
Model	798480662	4	199620165	18.1378	0.0000
Error	165086126	15	11005742	-	-
Total	963566788	19	-	-	-

Correlation Matrix

Q_t	1.0000			
Q_{t-1}	0.8263	1.0000		
ODA_t	0.6422	0.4930	1.0000	
CPI_t	0.8246	0.8137	0.4949	1.0000
$DUM85*HCJ_t$	-0.6613	-0.6742	-0.5218	-0.8849
	Q_t	Q_{t-1}	ODA_t	CPI_t

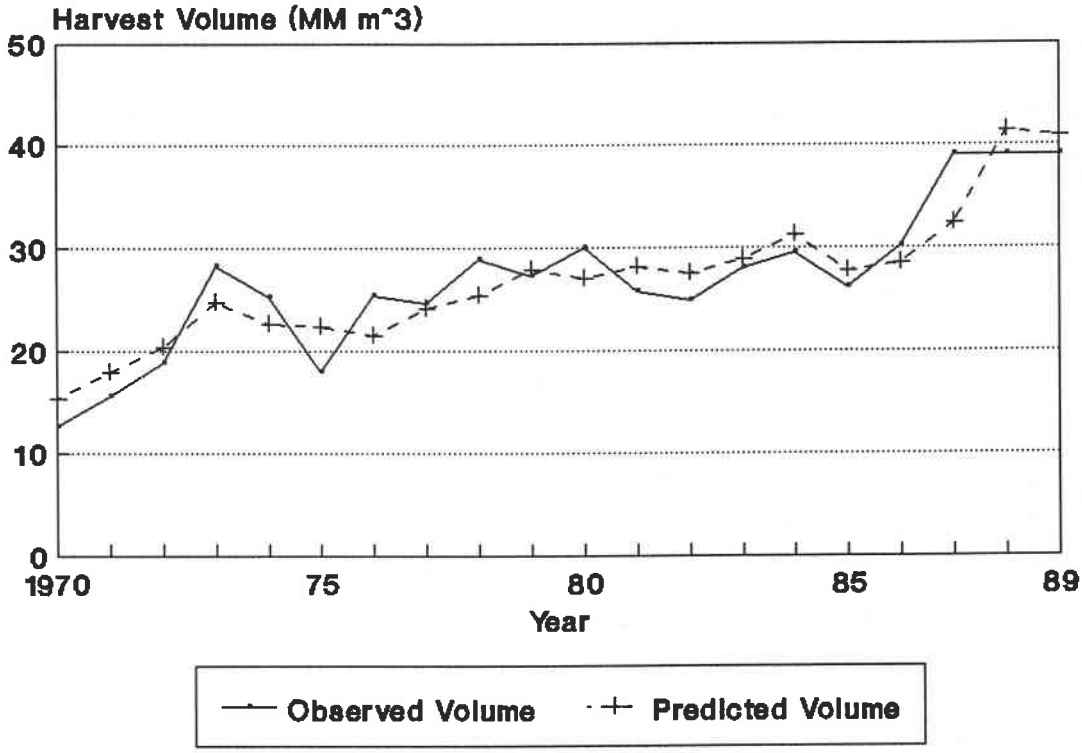

Figure V-1. Observed vs predicted timber harvest levels of Indonesia from 1970 to 1989.

Table V-2. Model fitting results of the reduced form tropical hardwood timber market equation in the Philippines.

Variable	Coefficient	Std. error	t-stat.	p-value
CONSTANT	3749.949837	2505.535413	1.4967	0.1552
Q_{t-1}	0.603653	0.187676	3.2165	0.0058
ODA_t	105.334235	63.810477	1.6507	0.1196
CPI_t	-29.822448	14.904419	-2.0009	0.0638
$DUM86*HCJ_t$	0.433723	0.781667	0.5549	0.5872

R^2	:	0.922582
Adjusted R^2	:	0.901937
Standard error	:	782.068
Durbin-Watson stat.	:	1.98914
Durbin h statistic	:	0.00893
Observation number	:	20

Analysis of variance

Source	Sum of Square	DF	Mean Square	F-ratio	P-value
Model	109330854	4	27332714	44.6883	0.0000
Error	9174453	15	611630	-	-
Total	118505308	19	-	-	-

Correlation Matrix

Q_t	1.0000			
Q_{t-1}	0.9452	1.0000		
ODA_t	-0.6167	-0.6778	1.0000	
CPI_t	-0.9141	-0.9182	0.7861	1.0000
$DUM86*HCJ_t$	0.7912	0.8156	-0.8648	-0.8819
	Q_t	Q_{t-1}	ODA_t	CPI_t

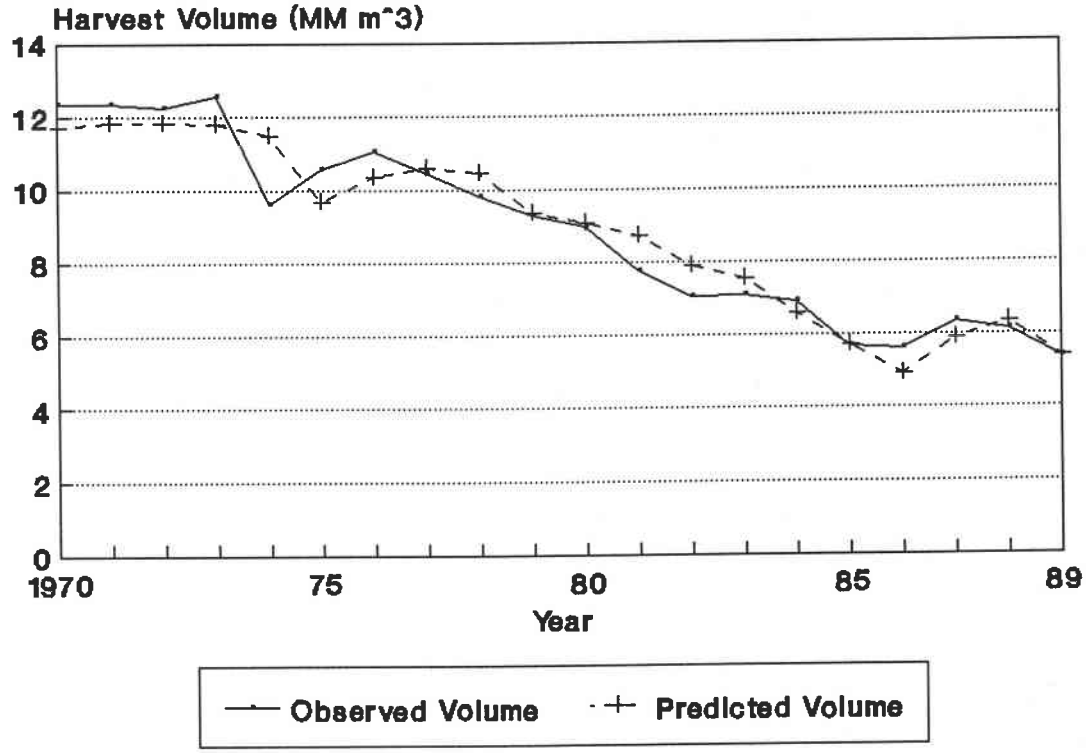

Figure V-2. Observed vs predicted timber harvest levels of the Philippines from 1970 to 1989.

Table V-3. Model fitting results of the reduced form tropical hardwood timber market equation in Malaysia.

Variable	Coefficient	Std. error	t-stat.	p-value
CONSTANT	-22789.13	6192.694518	-3.6800	0.0025
Q_{t-1}	0.067091	0.220794	0.3039	0.7657
ODA_t	2.499777	1.221045	2.0472	0.0599
CPI_t	351.246099	75.317558	4.6635	0.0004
HCJ_t	12.451776	2.396828	5.1951	0.0001
DUM85	5174.070034	1650.879179	3.1341	0.0073

R^2	:	0.954196
Adjusted R^2	:	0.937838
Standard error	:	1610.41
Durbin-Watson stat.	:	1.94035
Durbin h statistics	:	0.0393
Observation number	:	20

Analysis of variance

Source	Sum of Square	DF	Mean Square	F-ratio	P-value
Model	756376184	5	151275237	58.3304	0.0000
Error	36307885	14	2593420	-	-
Total	792684069	19	-	-	-

Correlation Matrix

	Q_t	Q_{t-1}	ODA_t	CPI_t	HCJ_t
Q_t	1.0000				
Q_{t-1}	0.9153	1.0000			
ODA_t	0.5346	0.5445	1.0000		
CPI_t	0.8969	0.9274	0.3775	1.0000	
HCJ_t	-0.0325	-0.2585	0.0595	-0.3316	1.0000
DUM85	-0.6124	-0.5654	-0.3569	-0.6748	-0.2101

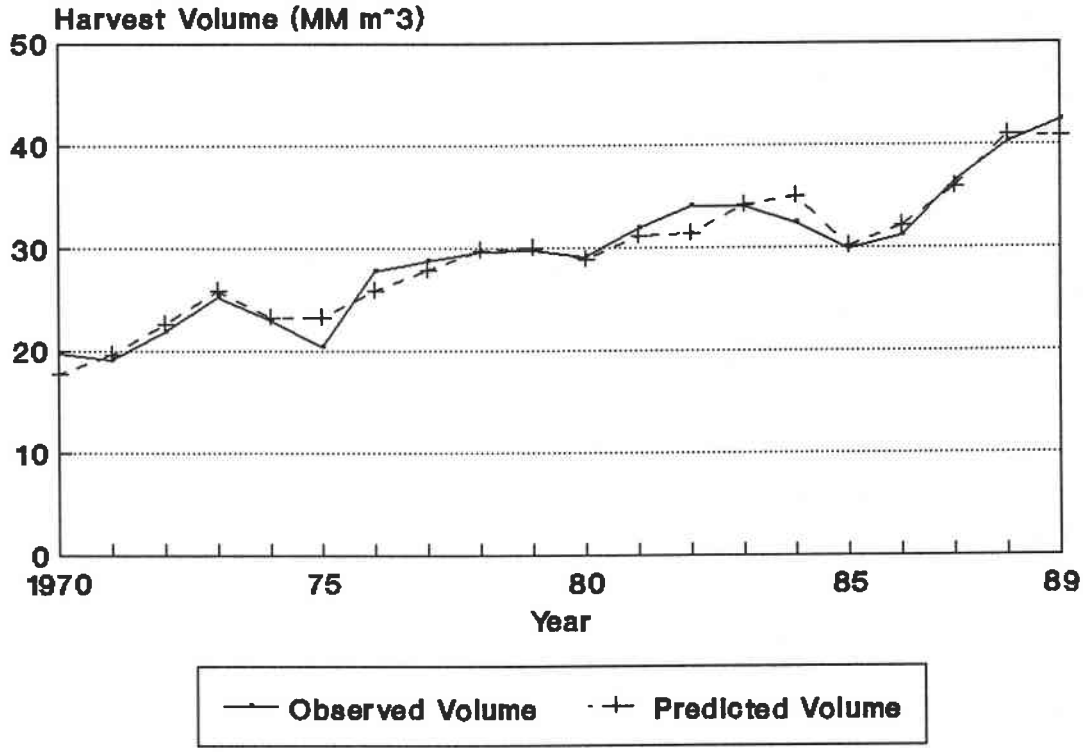

Figure V-3. Observed vs predicted timber harvest levels of Malaysia from 1970 to 1989.

V-2 GRANGER CAUSALITY TEST ANALYSIS

I analyzed the following causal relationships for each of the three countries:

1. Q ⇋ ODA
2. Q ⇋ HCJ
3. ODA ⇋ HCJ

Indonesia

There is no evidence of causal effect between Q and ODA in any of the 1 to 4 year lagged models. On the other hand, there is clear evidence of unidirectional causality from HCJ to Q. Three out of four tests reject the hypothesis that HCJ does not Granger-cause Q at 99% C.I. Another interesting result is that HCJ causes ODA, and there is also evidence of causality from ODA to HCJ. Three out of four tests reject the hypothesis that HCJ does not Granger-cause ODA at 95% C.I., and one out of four tests reject the hypothesis that ODA does not Granger-cause HCJ at 95% C.I.

R^2 of full models and reduced models, and F-statistics of Granger causality tests for Indonesia are shown in Table V-4, V-5, and V-6.

The Philippines

There is no evidence of causal effects between Q and ODA, between Q and HCJ, and between ODA and HCJ at all.

R^2 of full models and reduced models, and F-statistics of Granger causality tests for the Philippines are shown in Table V-7, V-8, and V-9.

Malaysia

There is clear evidence of unidirectional causality from Q to ODA. Three out of four tests reject the hypothesis that Q does not Granger-cause ODA at 95% C.I. There is also evidence of unidirectional causality from HCJ to Q. One out of four tests reject the hypothesis that HCJ does not Granger-cause Q at 95% C.I.

R^2 of full models and reduced models, and F-statistics of Granger causality tests for Malaysia are shown in Table V-10, V-11, and V-12.

The 5% significance levels of F-statistics of 1 to 4 year lagged models are as follows:

m = 1 : $F_{1,16}^{*} = 4.49$

m = 2 : $F_{2,13}^{*} = 3.81$

m = 3 : $F_{3,10}^{*} = 3.71$

m = 4 : $F_{4,7}^{*} = 4.12$

Table V-4. Results of the Granger causality test between Q and ODA for Indonesia.

Lagged Year	Model	ODA → Q		Q → ODA	
		R^2	F-stat.	R^2	F-stat.
m = 1	R_f^2	0.6106	$F_{1,16}$=0.551	0.4911	$F_{1,16}$=0.569
	R_r^2	0.5972		0.4730	
m = 2	R_f^2	0.6287	$F_{2,13}$=2.140	0.5386	$F_{2,13}$=0.757
	R_r^2	0.5065		0.4849	
m = 3	R_f^2	0.6393	$F_{3,10}$=1.788	0.5583	$F_{3,10}$=0.234
	R_r^2	0.4458		0.5273	
m = 4	R_f^2	0.7828	$F_{4,7}$=1.234	0.8342	$F_{4,7}$=3.171
	R_r^2	0.6297		0.5338	

significant at : * 95% C.I. ; ** 99% C.I.

Table V-5. Results of the Granger causality test between Q and HCJ for Indonesia.

Lagged Year	Model	HCJ → Q		Q → HCJ	
		R^2	F-stat.	R^2	F-stat.
m = 1	R_f^2	0.6066	$F_{1,16}$=0.382	0.4320	$F_{1,16}$=1.014
	R_r^2	0.5972		0.3960	
m = 2	R_f^2	0.8214	$F_{2,13}$=11.461**	0.5165	$F_{2,13}$=0.897
	R_r^2	0.5065		0.4498	
m = 3	R_f^2	0.8140	$F_{3,10}$=6.599**	0.5887	$F_{3,10}$=0.383
	R_r^2	0.4458		0.5414	
m = 4	R_f^2	0.9702	$F_{4,7}$=19.996**	0.6824	$F_{4,7}$=0.993
	R_r^2	0.6297		0.5021	

significant at : * 95% C.I. ; ** 99% C.I.

Table V-6. Results of the Granger causality test between ODA and HCJ for Indonesia.

Lagged Year	Model	HCJ → ODA		ODA → HCJ	
		R^2	F-stat.	R^2	F-stat.
m = 1	R_f^2	0.4826	$F_{1,16}$=0.297	0.3961	$F_{1,16}$=0.003
	R_r^2	0.4730		0.3960	
m = 2	R_f^2	0.7453	$F_{2,13}$=6.645*	0.4737	$F_{2,13}$=0.295
	R_r^2	0.4849		0.4498	
m = 3	R_f^2	0.7860	$F_{3,10}$=4.030*	0.6608	$F_{3,10}$=1.173
	R_r^2	0.5273		0.5414	
m = 4	R_f^2	0.8868	$F_{4,7}$=5.457*	0.8622	$F_{4,7}$=4.573*
	R_r^2	0.5338		0.5021	

significant at : * 95% C.I. ; ** 99% C.I.

Table V-7. Results of the Granger causality test between Q and ODA for the Philippines.

Lagged Year	Model	ODA → Q		Q → ODA	
		R^2	F-stat.	R^2	F-stat.
m = 1	R_f^2	0.8855	$F_{1,16}$=0.601	0.7180	$F_{1,16}$=3.489
	R_r^2	0.8812		0.6565	
m = 2	R_f^2	0.8823	$F_{2,13}$=0.370	0.7890	$F_{2,13}$=3.262
	R_r^2	0.8756		0.6831	
m = 3	R_f^2	0.9070	$F_{3,10}$=0.864	0.7857	$F_{3,10}$=1.104
	R_r^2	0.8829		0.7147	
m = 4	R_f^2	0.9076	$F_{4,7}$=0.324	0.8140	$F_{4,7}$=0.297
	R_r^2	0.8905		0.7824	

significant at : * 95% C.I. ; ** 99% C.I.

Table V-8. Results of the Granger causality test between Q and HCJ for the Philippines.

Lagged Year	Model	HCJ → Q		Q → HCJ	
		R^2	F-stat.	R^2	F-stat.
m = 1	R_f^2	0.8909	$F_{1,16}$=1.423	0.3978	$F_{1,16}$=0.048
	R_r^2	0.8812		0.3960	
m = 2	R_f^2	0.8854	$F_{2,13}$=0.556	0.4584	$F_{2,13}$=0.103
	R_r^2	0.8756		0.4498	
m = 3	R_f^2	0.9129	$F_{3,10}$=1.148	0.6841	$F_{3,10}$=1.506
	R_r^2	0.8829		0.5414	
m = 4	R_f^2	0.9052	$F_{4,7}$=0.344	0.6125	$F_{4,7}$=0.499
	R_r^2	0.8905		0.5021	

significant at : * 95% C.I. ; ** 99% C.I.

Table V-9. Results of the Granger causality test between ODA and HCJ for Philippines

Lagged Year	Model	HCJ → ODA		ODA → HCJ	
		R^2	F-stat.	R^2	F-stat.
m = 1	R_f^2	0.6608	$F_{1,16}$=0.203	0.4205	$F_{1,16}$=0.676
	R_r^2	0.6565		0.3960	
m = 2	R_f^2	0.7124	$F_{2,13}$=0.662	0.4906	$F_{2,13}$=0.521
	R_r^2	0.6831		0.4498	
m = 3	R_f^2	0.7446	$F_{3,10}$=0.390	0.5984	$F_{3,10}$=0.473
	R_r^2	0.7148		0.5414	
m = 4	R_f^2	0.8138	$F_{4,7}$=0.295	0.6391	$F_{4,7}$=0.664
	R_r^2	0.7824		0.5021	

significant at : * 95% C.I. ; ** 99% C.I.

Table V-10. Results of the Granger causality test between Q and ODA for Malaysia.

Lagged Year	Model	ODA → Q		Q → ODA	
		R^2	F-stat.	R^2	F-stat.
m = 1	R_f^2	0.8157	$F_{1,16}$=0.017	0.2814	$F_{1,16}$=5.947*
	R_r^2	0.8155		0.0143	
m = 2	R_f^2	0.7976	$F_{2,13}$=0.218	0.5139	$F_{2,13}$=6.489*
	R_r^2	0.7908		0.0286	
m = 3	R_f^2	0.8510	$F_{3,10}$=1.036	0.5921	$F_{3,10}$=4.378*
	R_r^2	0.8047		0.0564	
m = 4	R_f^2	0.8240	$F_{4,7}$=0.205	0.7048	$F_{4,7}$=3.311
	R_r^2	0.8034		0.1462	

significant at : * 95% C.I. ; ** 99% C.I.

Table V-11. Results of the Granger causality test between Q and HCJ for Malaysia.

Lagged Year	Model	HCJ → Q		Q → HCJ	
		R^2	F-stat.	R^2	F-stat.
m = 1	R_f^2	0.8165	$F_{1,16}$=0.087	0.4234	$F_{1,16}$=0.760
	R_r^2	0.8155		0.3960	
m = 2	R_f^2	0.8299	$F_{2,13}$=1.494	0.5196	$F_{2,13}$=0.944
	R_r^2	0.7908		0.4498	
m = 3	R_f^2	0.8902	$F_{3,10}$=2.596	0.5508	$F_{3,10}$=0.070
	R_r^2	0.8047		0.5414	
m = 4	R_f^2	0.9480	$F_{4,7}$=4.866*	0.5749	$F_{4,7}$=0.300
	R_r^2	0.8034		0.5021	

significant at : * 95% C.I. ; ** 99% C.I.

Table V-12. Results of the Granger causality test between ODA and HCJ for Malaysia.

Lagged Year	Model	HCJ → ODA		ODA → HCJ	
		R^2	F-stat.	R^2	F-stat.
m = 1	R_f^2	0.1399	$F_{1,16}$=2.336	0.4051	$F_{1,16}$=0.245
	R_r^2	0.0143		0.3960	
m = 2	R_f^2	0.1817	$F_{2,13}$=1.216	0.4889	$F_{2,13}$=0.497
	R_r^2	0.0286		0.4498	
m = 3	R_f^2	0.2785	$F_{3,10}$=1.026	0.7801	$F_{3,10}$=3.618
	R_r^2	0.0564		0.5414	
m = 4	R_f^2	0.4748	$F_{4,7}$=1.095	0.8454	$F_{4,7}$=3.886
	R_r^2	0.1462		0.5021	

significant at : * 95% C.I. ; ** 99% C.I.

CHAPTER VI : CONCLUSION

VI-1 SPECIFIC INTERCOUNTRY RELATIONSHIPS

Indonesia-Japan

The timber market model analysis suggests that Japanese ODA (ODA) to Indonesia is correlated to the timber harvest levels (Q) within the period. On the other hand, the Granger causality tests suggested that there is no temporal causal effect between Q and ODA. However, these two results do not exclude each other by introducing another variable, the number of new housing construction starts in Japan (HCJ).

Figure VI-1 shows the causal relationships between these three variables. While there is no direct causal relationship between Q and ODA, they change simultaneously because both of them changed by the effect of HCJ.

It is easily understood that HCJ "Granger-causes" Q. Timber export is one of the largest sources of foreign exchange for Indonesia[30], which is the least per capita income in ASEAN, and Japan is the major customer of their timber.

Among DAC countries, the amount of ODA is often shown as its proportion in the GNP. This implies the amount of ODA is related to the host country's economic situation. Indonesia is one of the most important countries for Japan in terms of

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[30]See appendix D for more information about Indonesian export industry.

foreign aid policy[31]. Large amounts of money are offered by Japan every year. Therefore, we can suppose that the amount of bilateral ODA to Indonesia is affected by the Japanese economic state.

The number of new housing construction starts is a good indicator of the economic state, so it is understandable that changes of the number of Japanese housing construction starts "causes" changes of its bilateral ODA to Indonesia.

In summary, I have found the possibility that the Japanese economic state affects both Indonesian tropical timber harvest levels and the bilateral ODA to Indonesia simultaneously. However, this result does not deny direct relationship between Q and ODA. Further studies might be able to find another interesting interpretation of this relationship.

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[31]According to Ministry of Foreign Affairs (1991), Indonesia is the biggest receiver of Japanese bilateral ODA in its cumulative amount.

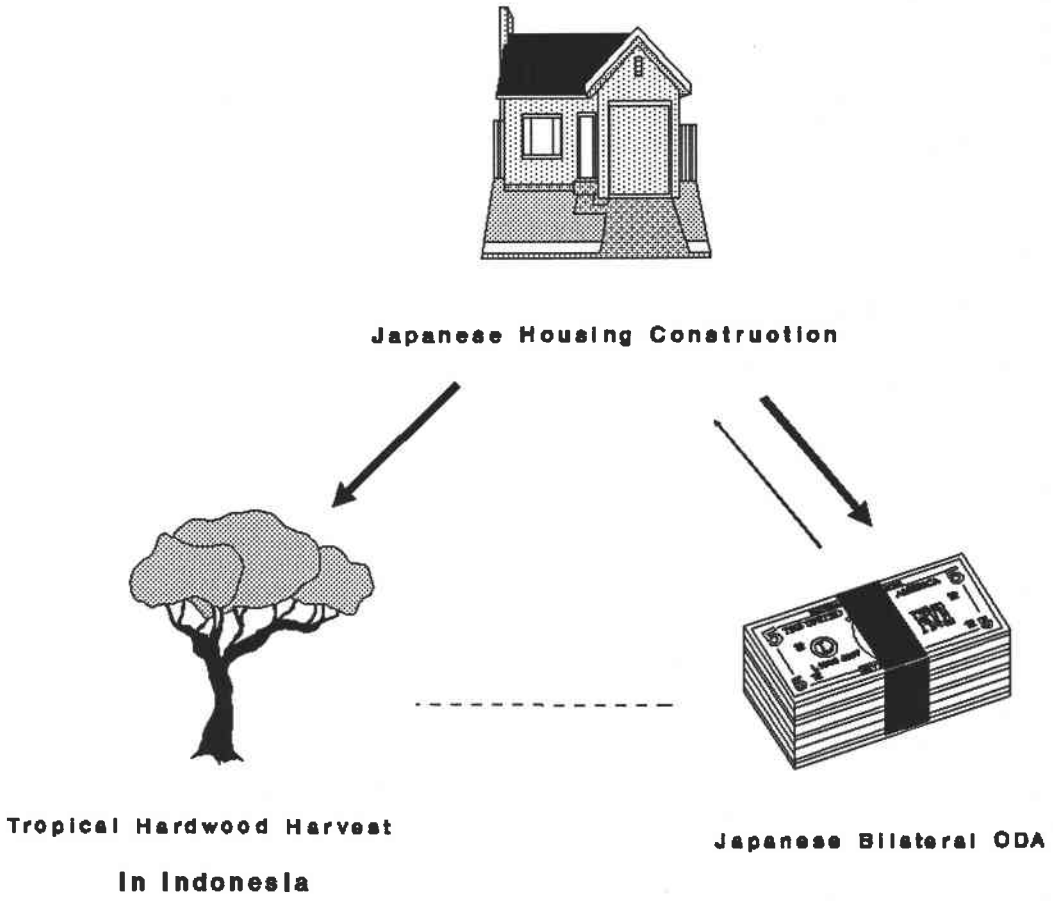

Figure VI-1. Relationship between Indonesia and Japan.

The Philippines-Japan

The results of analyses for the Philippines suggest no relationship between Japanese bilateral ODA to the Philippines and tropical timber harvest in it.

However, this is not surprising considering the trend of timber harvest in the Philippines. Their harvest volume has been decreasing steadily in the last 20 years[32], and timber industry is no more a major export industry today. Forest products was the largest single category of Philippines' export in late 1960s; it represented about 30% of the total export revenue. However, it occupied only 2.6% of the total in 1989 (IMF,1990).

Deforestation seems very severe in the Philippines. According to FAO (1982), and Porter and Ganapin (1988), the Philippines had about 16 million hectares of forest land in late 1960s, which was 53% of the total land area. However, it decreased 3200-3600 hectares annually in 1970s and remained about 11 million hectares in early 1980s. On the other hand, some studies analyzed by satellite photos estimated the forest land 6.8-7.3 million hectares in 1986 (Porter and Ganapin,1988) or about 6.5 million hectares in 1988 (Oka,1991). Productive forest areas must be more limited. Especially, the loss of dipterocarp old growth forests, which is the main source of timber in Southeast Asia, is extremely

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[32]I showed the trend of timber harvest levels of three countries in appendix A.

extensive. According to Oka (1991), 79% of remaining dipterocarp old growth forests in the Philippines had disappeared between 1969 and 1988 (ibid.,p.94).

One reason for the rapid deforestation in the Philippines might be the failure of the log export ban. In addition to this, a huge number of illegal logging operations is reported[33]. For example, in 1981, the Philippines recorded its log export to Japan 365 thousand cubic meters, while Japan recorded 1.42 million cubic meters (Porter and Ganapin, 1988); and 1986, the Philippine recorded 199.6 thousand cubic meters, while Japan recorded 288.4 thousand cubic meters (Nectoux and Kuroda, 1989). Because illegal logging is usually exploitative, it may play a big role for their deforestation.

The decrease in the Philippines' tropical timber harvest might be related to the decrease of its forest resources. It will be interesting to study this relationship.

Figure VI-2 shows the relationships between the Philippines and Japan. There are no significant evidence of relationships in it.

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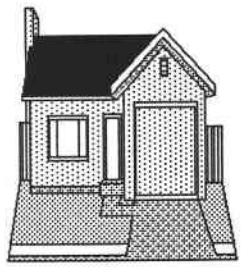
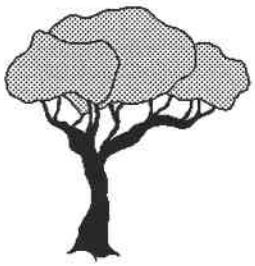
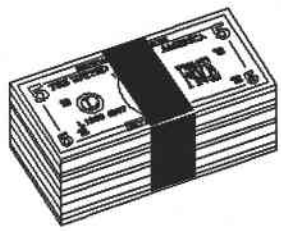
[33]A Japanese newspaper "The Yomiuri Shimbun (Feb.14,1992)" reported a latest incident of illegal logging in the Philippines. It showed the participation of military and public officers in illegal logging and transport of logs.



Japanese Housing Construction



Tropical Hardwood Harvest
in the Philippines



Japanese Bilateral ODA

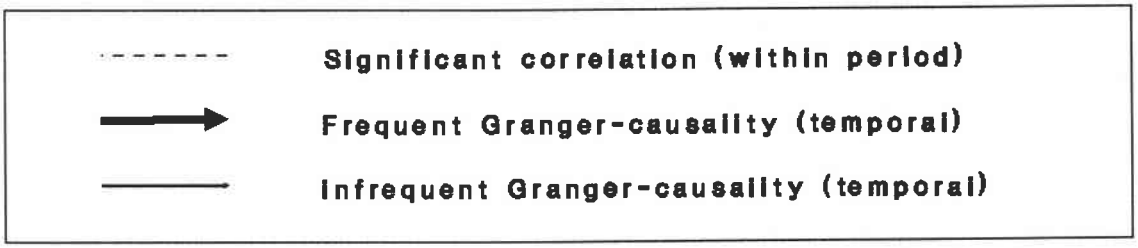


Figure VI-2. Relationship between the Philippines and Japan.

Malaysia-Japan

The timber market model for Malaysia suggests that ODA is correlated to Q within the period. In addition, the Granger causality test suggests that there is a temporal causal effect from Q to ODA.

As shown in appendix D, the per capita income of Malaysia is significantly higher than the two other countries. According to the Ministry of Foreign Affairs (1991), Malaysia is not the subject country of gifts of Japanese bilateral ODA as a general rule because of its high economic levels.

Against such middle income countries, ODA may be used for some political means, like reward or threat to make a certain political decision in subject countries. Thinking about the causal relationship from Q to ODA in Malaysia, it is possible to consider that Japanese bilateral ODA is used as a kind of a reward for log supply. This may be one of the elements that Morrison (1988) suggested[34].

A evidence of temporal causality is detected from HCJ to Q. There might not be causal relationship between them. However, like Indonesia, the timber industry is one of the major export industries in Malaysia, and Japan also is the

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[34]He explained the relationship between Malaysia and Japan as "Malaysia, with a per capita income of close to $2,000, would normally not be receiving ODA, but for political reasons, Japan continues to provide assistance to this country" (ibid.,p.439).

biggest market for them. Therefore it is reasonable that Japanese demand for timber "causes" log production in Malaysia.

Figure VI-3 shows the causal relationships between these three variables. The big arrow from Q to ODA is an outstanding feature of the relationship between Malaysia and Japan.

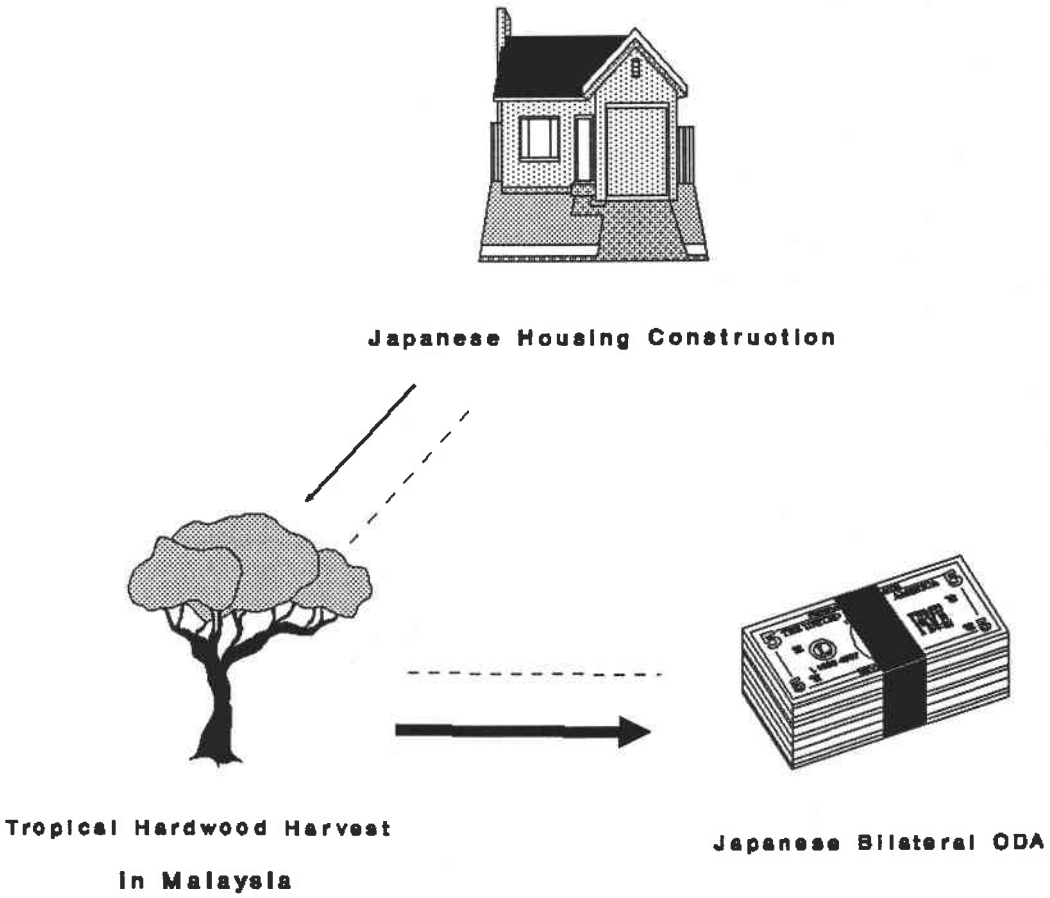

Figure VI-3. Relationship between Malaysia and Japan.

VI-2 Comprehensive Summary and Prospects

I get three different results from three different countries. Because of the diverse political, economic and forestry situations in those countries, it might not be necessary to be the same or similar results. It is rather reasonable to get different relationships with sufficient explanation for each.

I use the same variables in all three countries' tropical timber market equation, but they are able to differ from each other. Especially for the Philippines, a variable indicating either the area of productive forest land or the standing volume of trees might be included in the model, because it is critical for their timber production. With using the data of forest land, we can also analyze the relationship between timber harvest and deforestation. As well as ODA, private direct investment may have a big impact on the forestry sectors in Southeast Asian countries.

This generalization also works relatively well for Indonesia and Malaysia because analyses of the reduced form equation of these two country's tropical timber market shows similar results. Correlation between Japanese bilateral ODA and tropical timber harvest levels in these two countries is one of remarkable findings of this study.

Focusing on a certain region, we can discuss more deeply about the relationship between external capital flow into the region and timber harvest levels. For example, if we can get

the data of ODA receipts, private investment for timber sector, wage rate, transport and shipping cost, regional demand for timber, and other variables in Sabah, the result should be very interesting and it may be useful for forecasting what will happen in Sarawak and Papua New Guinea in the near future.

Because of the data availability, I use the exchanged official note values of Japanese bilateral ODA, but this is not exactly the same as actual transfer of assistance. There must be some time lag between the date of exchanging official notes and the date of transfer of the assistance materials. It might be better to built a model using the net disbursement value of ODA in every single year.

Thinking about the long-term prosperity, sustainable use of tropical forest resources is a necessary policy in Southeast Asia and other countries in the tropics. It should be a common prospect among the developed and the developing countries. ODA is to be used primarily for the benefit and welfare of the people in the recipient countries.

In the last few years, the Japanese government has tried to establish an effective system of environmental impact survey before starting projects sponsored by Japanese ODA. They also are interested in the research and the protection

of tropical forests[35] (Ministry of Foreign Affairs, 1991). The fact that they have begun to be concerned about environmental issues might show the fact that they had not concerned themselves earlier. However, they seem to be working hard to change themselves in cooperation with world environmental movements. I believe Japan is heading for a marked improvement in policy.

[35]It is worth mentioning that Japan is not only the biggest importer of tropical timber, but also the major contributor to the research of tropical forestry in the world today.

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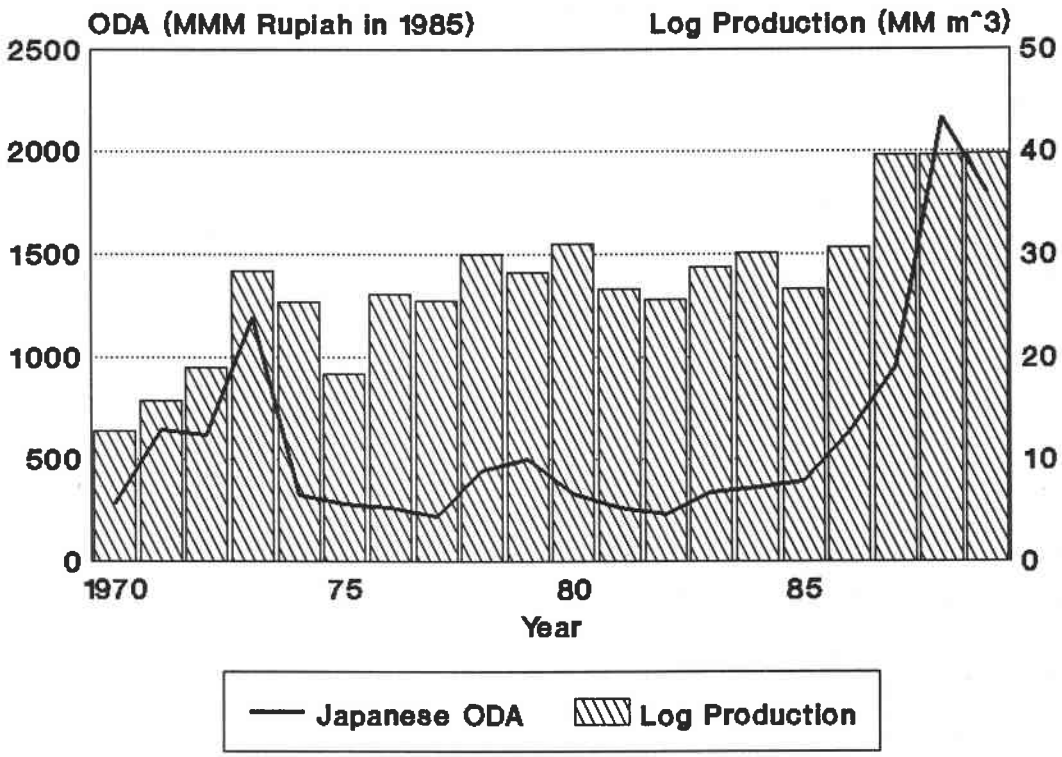
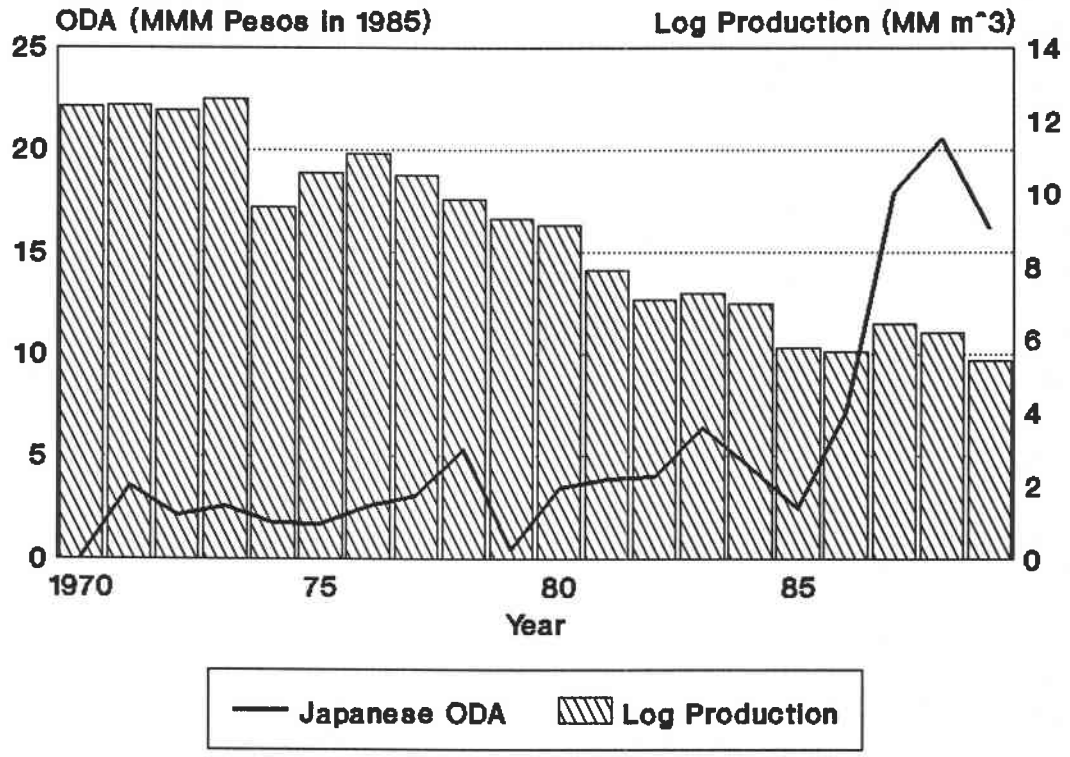
APPENDICES

APPENDIX A : TIMBER HARVEST LEVELS AND JAPANESE ODA



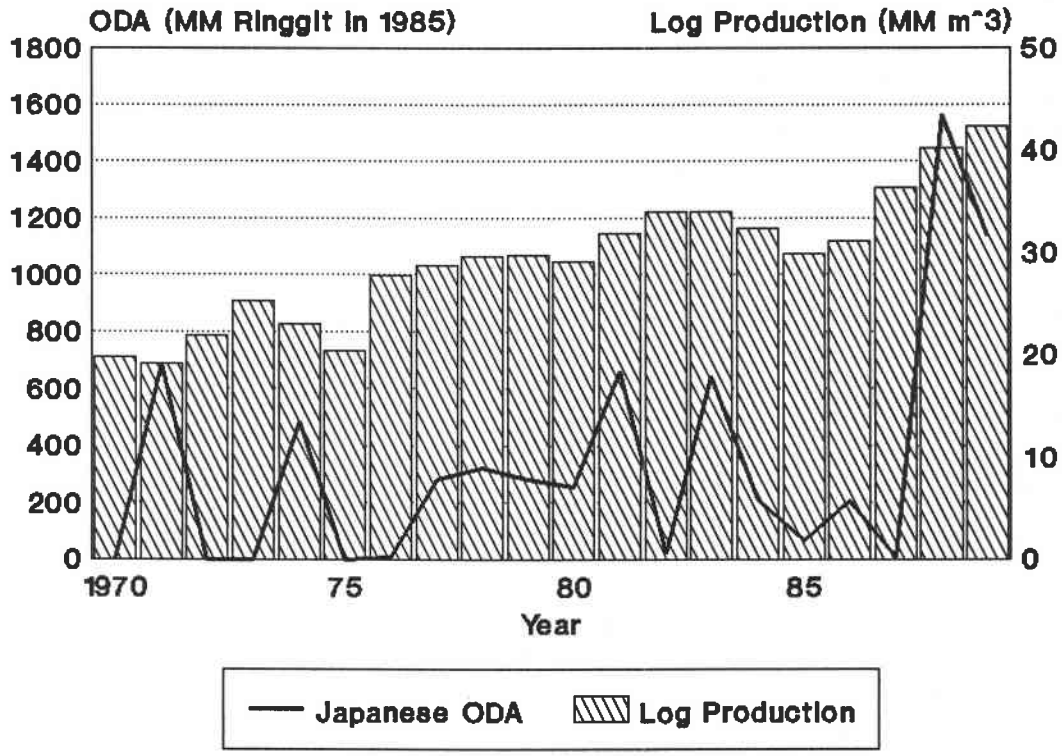
Source : FAO (1991) & Ministry of Foreign Affairs (1991)

Figure A-1. The trend in timber harvest levels in Indonesia and Japanese bilateral ODA to Indonesia from 1970 to 1989.



Source : FAO (1991) & Ministry of Foreign Affairs (1991)

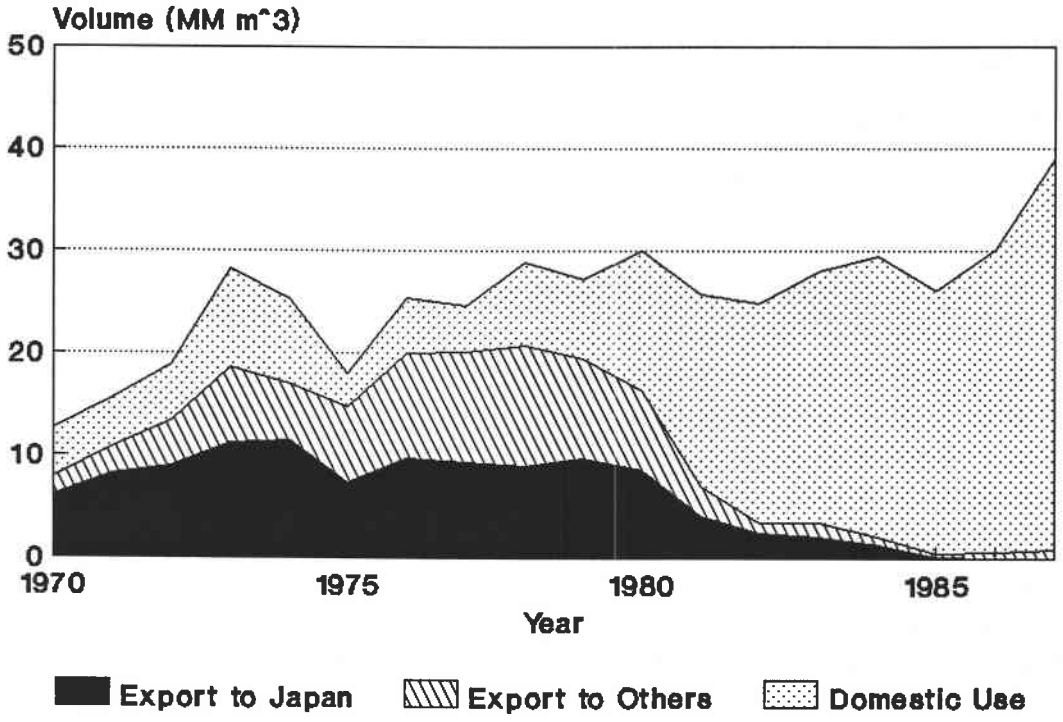
Figure A-2. The trend in timber harvest levels in the Philippines and Japanese bilateral ODA to the Philippines from 1970 to 1989.



Source : FAO (1991) & Ministry of Foreign Affairs (1991)

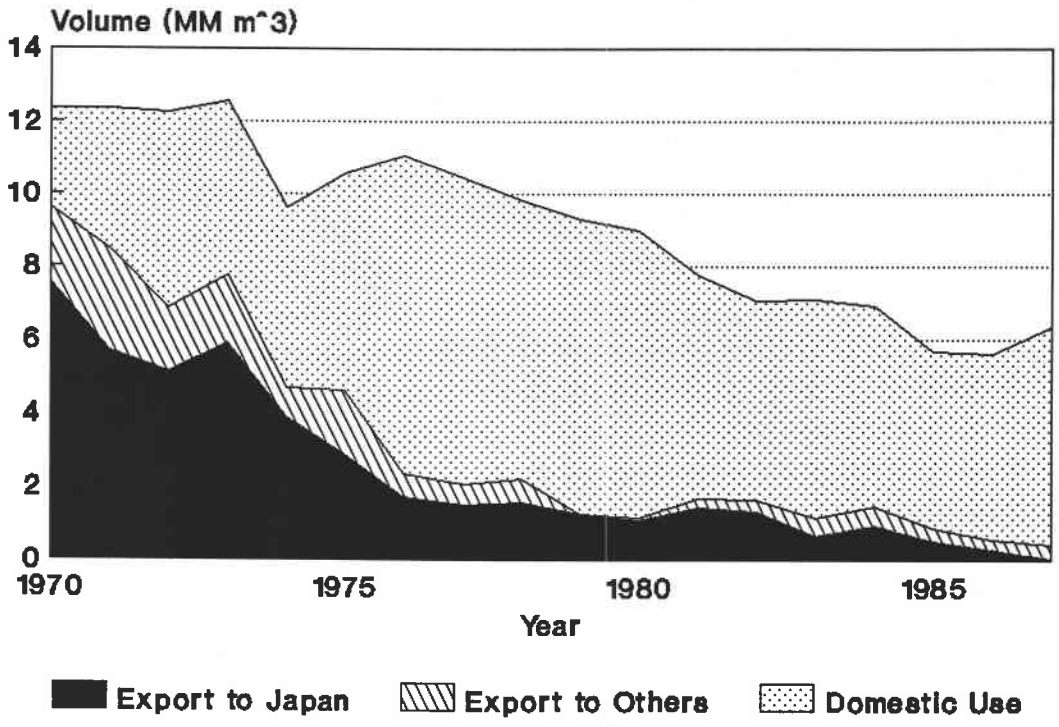
Figure A-3. The trend in timber harvest levels in Malaysia and Japanese bilateral ODA to Malaysia from 1970 to 1989.

APPENDIX B : DESTINATION OF TROPICAL TIMBER



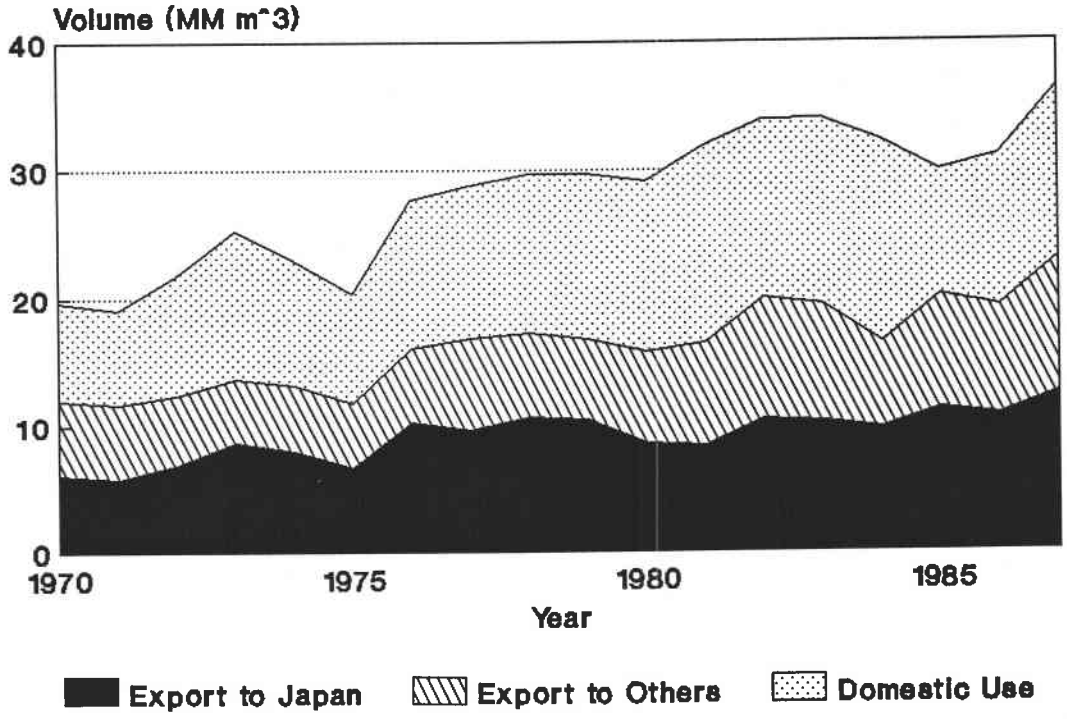
Source : FAO (1991) & Nectoux and Kuroda (1989a)

Figure B-1. Destination of tropical timber harvested in Indonesia from 1970 to 1987.



Source : FAO (1991) & Nectoux and Kuroda (1989a)

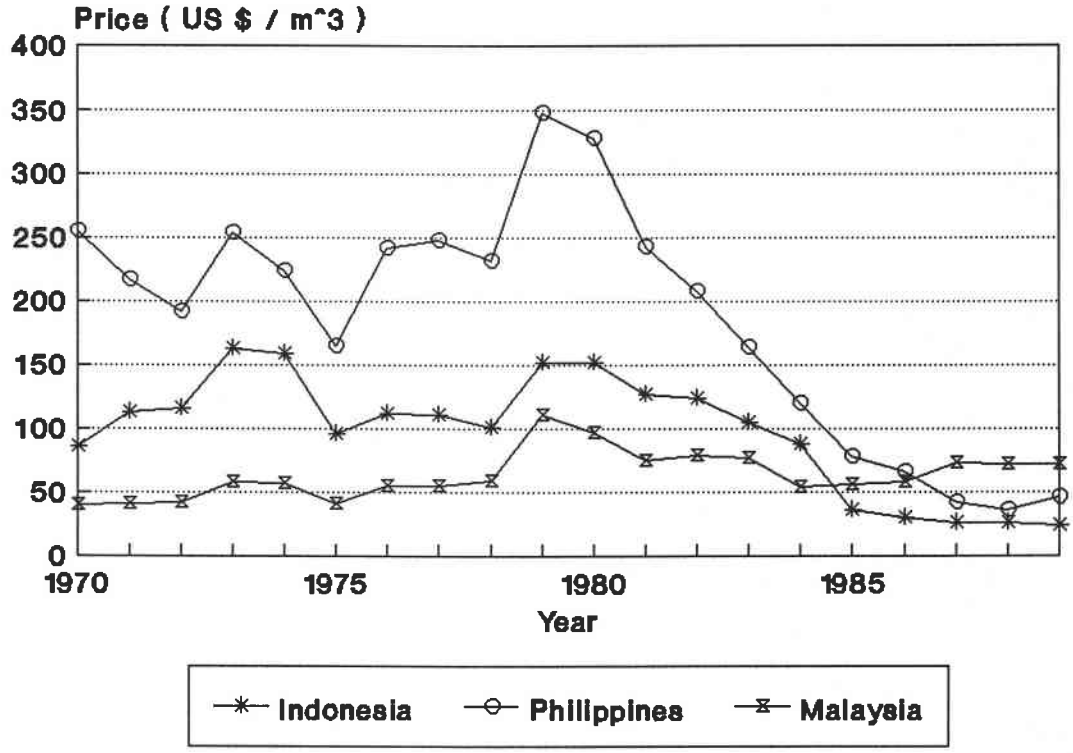
Figure B-2. Destination of tropical timber harvested in the Philippines from 1970 to 1987.



Source : FAO (1991) & Nectoux and Kuroda (1989a)

Figure B-3. Destination of tropical timber harvested in Malaysia from 1970 to 1987.

APPENDIX C : LOG EXPORT PRICES



Source : FAO (1991)

Figure C-1. The trend in average tropical hardwood roundwood export prices in Indonesia, the Philippines and Malaysia from 1970 to 1989 expressed by 1985 US dollars.

APPENDIX D : BASIC DATA FOR THE THREE COUNTRIES

Table D-1. The basic economic, demographic, and forestry data for Indonesia, the Philippines, and Malaysia.

	Indonesia	Philippines	Malaysia
Land Surface	1,905,000 km^2	300,000 km^2	330,000 km^2
Population (1989)	178.2 million	61.2 million	17.3 million
Pop. Density (1989)	93.5 / km^2	204.1 / km^2	52.5 / km^2
Pop. Increase Rate[a]	2.1 %	2.4 %	2.6 %
GNP (1989)	US $ 87.94 billion	US $ 42.75 billion	US $ 37.01 billion
GNP/capita (1989)	$490	$700	$2,130
GNP/cap. Inc. Rate[a]	3.6 %	-1.8 %	1.9 %
Forest Land Area[b]	1,439,710 km^2	63,830 km^2	198,330 km^2
Production Forest[b]	644,040 km^2	44,030 km^2	147,840 km^2
Deforestation Rate	0.8 % (av.1979-84)	1.5 % (av.1981-88)	1.25 % (av.1981-85)
% Manufacture in GDP[c]	13.9 %	25.1 %	25.6 %
% Agriculture in GDP[c]	25.5 %	23.0 %	18.2 %
% Trade with Japan[c]	25.6 %	18.7 %	19.9 %
Major Imports (1988-89: Indonesia) (1988 : Philippines & Malaysia)	Capital Equipments: $3.37 billion Oil & Oil Products: $1.91 billion Base Metal: (1988) $1.09 billion Chemical Products: $840 million	Raw Materials & Intermediate Goods: $4.17 billion Capital Goods: $1.74 billion Mineral Fuels & Lubricants: $1.10 billion Consumer Goods: $740 million	Machinery & Transport Equipment: $7.20 billion Manufactured Goods: $3.65 billion Food: $1.43 billion
Major Exports (1988-89: Indonesia) (1988 : Philippines & Malaysia)	Oil & Oil Products: $5.00 billion Timber: $2.87 billion LNG: $2.63 billion Textiles, Garments, & Handicrafts: $1.79 billion Rubber : $1.29 billion	Electronics: $1.48 billion Garments: $1.32 billion Coconut Oil: $408 million Fish: $307 million Copper Metal: $295 million Chemicals: $256 million	Manufactured Goods: $3.10 billion Crude Petroleum: $2.28 billion Rubber: $1.95 billion Palm Oil: $1.68 billion Sawn Logs: $1.49 billion Tin: $339 million

[Note] [a] : 1981-89 average [b] : 1986 [c] : 1988

Source : Ministry of Foreign Affairs (1991), Nectoux and Kuroda (1989a), Gillis (1988b), WRI (1990), and Far East Economic Review (1990).