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Economic Impacts of Tropical Timber Sector in Malaysia

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Abstract: This paper investigated the inter-linkages between the timber sector and other sectors in Malaysia's economy and calculated the output, household income, final demand, exports, imports, private consumption, government consumption, investment and value added. The input-output model was used to calculate and evaluate the economic impacts for Malaysia. In this study, the input-output table 2000 for Malaysia was built in order to develop the Malaysia's economy. The 94 sectors in the intermediate output of the Malaysia were aggregated to 14 sectors so that it reflected the economy of Malaysia. Our results showed that there are significant economic impacts on GDP of Malaysia. The purpose of this study was to highlight and clarify the economic impacts of tropical timber sector in Malaysia.

Key words: Input-output analysis, economic impacts, tropical timber sector.

INTRODUCTION

Input-output analysis is an excellent descriptive tool showing in detail the structure of an existing regional economy. It provides important information on individual industrial sector size, and its behaviour and interaction with the rest of the economy. It is one of many tools available for economic impact analysis although, for various reasons, the input-output approach is the most popular. Its popularity will continue to increase because the development of computers and software has made impact analysis much easier and more informative than it has been in the past. The use of the input-output framework to evaluate the impact of forest sector contributions to a region is not new.

Waggener, et al. (1976) used the input-output model to document the relationship of the forest industries to the 1976 Washington State economy. Their analysis on the role of forestry in the Washington economy, was rewarded with the documentation of the direct, indirect, and induced economic impact of the forest-based sector of the Washington economy in 1976. Ceperly, (1978) used the 1972 Washington State input-output model to evaluate the Gray Harbor County economy. She evaluated the effectiveness of the non-survey technique of deriving the input-output model. She also used the location quotient reduction method to derive the coefficient matrices and output multipliers for Gray Harbor County from the 1972 Washington State input-output model.

Alward, (1980) addressed the application of input-output modeling in the forestry sector by integrating the two separate components of the Forest's Service planning analysis process, i.e., resource allocation and scheduling, and input-output analysis. He used this integrated model to evaluate the regional economic policies of the Rio Grande National Forest, in Colorado.

Hite, (1989) developed a simulation model to evaluate the economic impacts of retaining more timber within the California's Northern interior for processing and remanufacturing. He employed the IMPLAN model, to calculate the employment and personal income multipliers which were used as inputs to his primary model. Sihite, (1990) developed the input-output model for the Kalamazoo County from Michigan. He also employed IMPLAN model to regionalize the input-output table, the forest sector was used in the analysis.

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Norini, (1991) focussed on economic linkages between forest based industry and other sectors in the Malaysian economy. She also determined the key industries of the forest based industry sector. Based on the Malaysian Input-Output table of 1983, she determined that out of 60 sectors only three sectors, i.e., (1) forestry, (2) sawmills and other wood mills and (3) furniture and fixtures, are associated with the forest-based industries.

Khamurudin, (1996) modified an input-output model of wood based industry in Sarawak during 1990-2005 to estimate the level of harvest and evaluate the economic impacts of the industrialization strategy of the forestry and timber sector in Sarawak. The wood-based industry development in Sarawak became a critical issue because the development strategy was implemented during the period of rapidly changing forestry conditions and harvest level due to growing concern for sustainable management from inside and outside the country. Based on the Malaysian Input-Output table of 1983, he determined that out of 60 sectors only 27 sectors, The results of the model indicated that a combination of control on the logs export and forest management simulation would provide a best option to Sarawak in its present situation.

The aim of this study is to obtain the economic impacts of tropical timber sector in Malaysia and calculate the output, household income, value added, exports, imports, private consumption, government consumption, investment and the final demand.

MATERIALS AND METHODS

French economist, Fracois Quesnay gave the first original idea of developing interindustry accounting in his book, Tableau Economique in 1758. He presented his idea by describing how a landowner spends the income he received from his rent on agricultural products and products from artisans, and how the farmers and artisans, on the other hand, buy industrial products and so on. Wassily Leontief formalized this idea in the late 1930's which is now known as input-output analysis.

The methodology of this study is based on Leontief's input-output framework (e.g. Miller and Blair, 1985) where the structure of an economy is analyzed in terms of interrelationships between timber sectors. Generally the input–output model describes the relationship among economic sectors are described through the use of a system of linear equations, which represent the identity between the total output produced and the output purchased and consumed by all other sectors of the system. In other words, everything produced by a sector is purchased and consumed respectively by the other ones as inputs or by the consumer as final demand.

Mathematical Formulation of Input-Output Model:

Basically, there are three major matrices used in the analysis of input-output model. They are i) regional transaction matrix(X); and ii) direct coefficient matrix (A); iii) direct and indirect inverse coefficient matrix (Q).

Regional Transaction Matrix (X):

Assuming we have n industries in an economy, the total gross output of sector i, can be written as:

$$X_i = \sum_{j=1}^{n} z_{ij} + Y_i \tag{1}$$

Where,

z_{ij} is the sales of output from sector i to other industries identified as industry j, and

Yi is the aggregate final demand for sector i.

Column *j,* gives the total purchases of industry *j.* The purchases by industry *j* come from three major components. These components are intermediate inputs (z_{ij}), primary inputs (v_{ij}), and imports (m_{ij}). While intermediate inputs are produced by the other local producing sectors, the primary inputs are the value added components in the form of wages, profit, rent, interest and taxes.

The total input of a consuming sector *j,* can be written as:

$$X_j = \sum_{i=1}^{n} z_{ij} + V_j + M_j \tag{2}$$

Where,

z_{ij} is the input from sector i to produce commodity j

V_j is the aggregate value added to sector j

M_j is the aggregate import of input to sector j.

The total input is equal to the total output for each sector ($X_i=X_j$, where $i=j$).

Direct Coefficient Matrix (A):

The direct input coefficients represent the input of each specific industry relative to a unit of output. The direct input coefficient, a_{ij}, is given by:

$$a_{ij} = \frac{z_{ij}}{X_j} \tag{3}$$

Where,

a_{ij} is the direct input requirement by sector j of the output of sector i per unit of output of sector j. Rearranging equation (3)

$$z_{ij} = (X_j)(a_{ij}) \tag{4}$$

And substitute it into equation (1),

$$X_i = \sum_{j=1}^{n} a_{ij} X_j + Y_i \tag{5}$$

Equation (5) indicates the following assumptions:

i) There is no joint production because each commodity output is supplied by a single industry sector using one method of production;

ii) The constant returns to scale and no input substitution, which is implied by the use of linear input functions; and

iii) The external economies and diseconomies are ruled out by the addivity, which means the total effect of production is the sum of the separate effects (Richardson, 1972).

Direct and Indirect Inverse Coefficient Matrix (Q):

The direct and indirect input coefficients represent the inputs on all industries in the economy, of final demand upon gross output, given the input coefficients matrix. In order to capture the first, second and higher order effects in a single equation, we express equation (5) in a matrix form:

$$X = AX + Y \tag{6}$$

Where,

X is a column vector of gross output

Y is a column vector of final demand

A is an n x n matrix of direct input coefficients, a_{ij}.

Equation (6) can be rearranged as:

$$X - AX = Y \tag{7}$$

By factoring and using an identity matrix, I, the above equation can be rewritten as

$$X(I - A) = Y \tag{8}$$

From equation (5.8), we can express the gross output as:

$$X = (I - A)^{-1} Y \tag{9}$$

Equation (9) will hold on the condition that matrix *(I - A)* has an inverse. This condition wil1 be met if the Y vector has at least one non-zero element (Richardson, 1972). The matrix $(I - A)^{-1}$ is also known as Leontief inverse matrix.

Letting, $Q = (I - A)^{-1}$, we may write the equation (9) as

$$X = QY \tag{10}$$

Richardson, (1972) called each entry in Q the interdependency coefficient. The coefficient q_{ij} is the direct and indirect requirements for sector *i* per unit of final demand for the output of sector *j*. By multiplying the inverse matrix, Q, by any size of final demand, *Y,* we can obtain the level of gross output, X, for each industry.

Input-Output Table for Malaysia:

In this study, the input-output table 2000 for Malaysia was built in order to develop the Malaysia's economy. The 94 sectors in the intermediate output of the Malaysia were aggregated to 14 sectors so that it will reflect the economy of Malaysia. The sectors were aggregated based on their contribution to the Malaysia's Gross Domestic Product (GDP) and the data available to the researcher.

Let, for Malaysian input-output table 2000, P is the aggregation matrix and R is the unaggregated 94 x 94 transaction matrix and R* is the corresponding aggregated 14 x 14 transaction matrix. Similarly, Y and Y* are the unaggregated and aggregated vectors of final demand, respectively.

The aggregated final demand, *Y**, can be obtained from

$$Y^* = PY \tag{11}$$

The aggregated transaction matrix, R*, is given by

$$R^* = PRP/ \tag{12}$$

Where, *P′* is the transposed of matrix *P*.

The new corresponding total output, *X** can be obtained from

$$X^* = R^*t - Y \tag{13}$$

Where, *i* is the column vector of ones.

RESULTS AND DISCUSSION

Impact of Selected Timber Based Scenarios on the Malaysian Economy:

Impacts of Output Scenario:

The distribution of the timber based products output is summarized in Table 1. In this scenario, the total 2008 output for the Malaysian economy was estimated to be RM 891.50 billion. From the table, it can be seen that the output of the industry was the major output which was RM 358.08 billion (40.17%) of the total output. The output of the forestry sector was constituted to be RM 11.19 billion (1.26%) and the wood products RM 27.73 billion (3.11%) respectively.

Impacts of Value Added Scenario:

The distribution of the timber based products value added is summarized in Table 2. In this scenario, the total 2008 value added for the Malaysian economy was estimated to be RM 341.22 billion. From the table, it can be seen that the value added of the industry was the major value added which was RM 73.67 billion (21.59%) of the total value added. The value added of the forestry sector was constituted to be RM 8.3 billion (2.42%) and the wood products RM 5.96 billion (1.75%) respectively.

Impacts of Income Scenario:

The distribution of the income from the timber based products is summarized in Table 3. In this scenario, the total 2008 income for the Malaysian economy was estimated to be RM 97.71 billion. From the table, it can be seen that the income from the trade was the major income which was RM 19.50 billion (19.96%) of the total income. The income from the forestry sector was constituted to be RM 1.52 billion (1.56%) and the wood products RM 2.67 billion (2.73%) respectively.

Impacts of Investment Scenario:

The distribution of the timber based products investment is summarized in Table 4. In this scenario, the total 2008 investment for the Malaysian economy was estimated to be RM 52.66 billion. From the table, it can be seen that the investment of the trade was the major investment which was RM 41.98 billion (79.71%) of the total investment and minor (negative) investment of industry RM -114.60 million (-0.22%) respectively. The investment of the forestry sector was constituted to be RM 1.17 billion (2.22%) and the wood products RM 1.09 billion (2.07%) respectively.

Impacts of Export Scenario:

The distribution of the timber based product exports is summarized in Table 5. In this scenario, the total 2008 export for the Malaysian economy was estimated to be RM 403.04 billion. From the table, it can be seen that the exports of the industry was the major exports which was RM 266.52 billion (66.13%) of the total exports. The exports of the forestry sector was constituted to be RM 2.57 billion (0.64%) and the wood products RM 12.79 billion (3.17%) respectively.

Impacts of Import Scenario:

The distribution of the timber based product imports is summarized in Table 6. In this scenario, the total 2008 import for the Malaysian economy was estimated to be RM 278.58 billion. From the table, it can be seen that the imports of the industry was the major imports which was RM 184.30 billion (66.16%) of the total imports. The imports of the forestry sector was constituted to be RM 1.30 billion (0.47%) and the wood products RM 5.66 billion (2.03%) respectively.

Impacts of Final Demand Scenario:

The distribution of the timber based product final demand is summarized in Table 7. In this scenario, the total 2008 final demand for the Malaysian economy was estimated to be RM 619.80 billion. From the table, it can be seen that the final demand of the industry was the major imports which was RM 280.87 billion (45.32%) of the total final demand. The final demand of the forestry sector was constituted to be RM 3.74 billion (0.60%) and the wood products RM 16.25 billion (2.62%) respectively.

Impacts of Private Consumption Scenario:

The distribution of the private consumption of the timber based product is summarized in Table 8. In this scenario, the total 2008 private consumption for the Malaysian economy was estimated to be RM 129.23 billion. From the table, it can be seen that the private consumption of the financial services was the major private consumption which was RM 37.94 billion (29.36%) of the private consumption. The private consumption of the forestry sector was constituted to be RM 0.00 and the wood products RM 2.38 billion (1.84%) respectively.

Table 1: Total Output for each sector (Million RM).

	Output	% of total output
Agriculture	20918.02	2.35
Forestry	11190.69	1.26
Manufacturing	123113.29	13.81
Wood Products	27733.14	3.11
Industry	358077.58	40.17
Instrument & Equipment	30354.88	3.40
Electricity & Gas	17380.09	1.95
Trade	118343.31	13.27
Transportation	52043.72	5.84
Financial Services	82592.29	9.26
Education & Health Services	20785.63	2.33
Private & Non-profit Services	1043.33	0.12
Entertainment	5058.80	0.57
Other Services	22864.97	2.56
Total Intermediate	891499.74	100.00

Table 2: Total value added for each sector (Million RM)

	Value Added	% of total value added
Agriculture	11820.55	3.46
Forestry	8252.49	2.42
Manufacturing	55432.27	16.25

Table 2: Continue

Wood Products	5963.08	1.75
Industry	73670.64	21.59
Instrument & Equipment	7142.25	2.09
Electricity & Gas	10767.51	3.16
Trade	59838.33	17.54
Transportation	22178.12	6.50
Financial Services	57158.21	16.75
Education & Health Services	14342.35	4.20
Private & Non-profit Services	504.76	0.15
Entertainment	3000.56	0.88
Other Services	11147.11	3.27
Total Intermediate	341218.22	100.00

Table 3: Total income for each sector (Million RM).

	Income	% of total income
Agriculture	1751.55	1.79
Forestry	1524.67	1.56
Manufacturing	6689.92	6.85
Wood Products	2671.62	2.73
Industry	17743.30	18.16
Instrument & Equipment	2444.02	2.50
Electricity & Gas	940.22	0.96
Trade	19499.95	19.96
Transportation	7171.07	7.34
Financial Services	12724.33	13.02
Education & Health Services	13408.22	13.72
Private & Non-profit Services	481.21	0.49
Entertainment	654.76	0.67
Other Services	10007.87	10.24
Total Intermediate	97712.71	100.00

Table 4: Total investment for each sector (Million RM)

	Investment	% of total investment
Agriculture	1250.92	2.38
Forestry	1169.80	2.22
Manufacturing	2510.12	4.77
Wood Products	1088.38	2.07
Industry	-114.60	-0.22
Instrument & Equipment	4230.94	8.03
Electricity & Gas	0.00	0.00
Trade	41976.30	79.71
Transportation	182.88	0.35
Financial Services	90.98	0.17
Education & Health Services	0.00	0.00
Private & Non-profit Services	0.00	0.00
Entertainment	0.00	0.00
Other Services	277.68	0.53
Total Intermediate	52663.39	100.00

Table 5: Total exports for each sector (Million RM)

	Exports	% of total exports
Agriculture	2451.93	0.61
Forestry	2567.86	0.64
Manufacturing	51780.64	12.85
Wood Products	12785.59	3.17
Industry	266515.08	66.13
Instrument & Equipment	11448.78	2.84
Electricity & Gas	5.30	0.00
Trade	11401.22	2.83
Transportation	20211.77	5.01
Financial Services	22559.40	5.60
Education & Health Services	359.66	0.09
Private & Non-profit Services	0.00	0.00
Entertainment	438.10	0.11
Other Services	516.91	0.13
Total Intermediate	403042.25	100.00

Table 6: Total imports for each sector (Million RM)

	Imports	% of total imports
Agriculture	1632.13	0.59
Forestry	1301.39	0.47
Manufacturing	19468.83	6.99
Wood Products	5660.61	2.03
Industry	184297.52	66.16
Instrument & Equipment	12564.07	4.51
Electricity & Gas	1635.06	0.59
Trade	20961.19	7.52
Transportation	12726.65	4.57
Financial Services	9868.94	3.54
Education & Health Services	3208.36	1.15
Private & Non-profit Services	157.42	0.06
Entertainment	384.54	0.14
Other Services	4703.02	1.69
Total Intermediate	278579.74	100.00

Table 7: Total final demand for each sector (Million RM)

	Final demand	% of total final demand
Agriculture	8520.51	1.37
Forestry	3737.66	0.60
Manufacturing	72951.06	11.77
Wood Products	16251.80	2.62
Industry	280874.13	45.32
Instrument & Equipment	21983.92	3.55
Electricity & Gas	3770.88	0.61
Trade	70128.26	11.31
Transportation	33722.41	5.44
Financial Services	60801.30	9.81
Education & Health Services	20694.93	3.34
Private & Non-profit Services	969.28	0.16
Entertainment	4598.12	0.74
Other Services	20793.70	3.35
Total Intermediate	619797.96	100.00

Table 8: Total private consumption for each sector (Million RM)

	Private consumption	% of total private consumption
Agriculture	4817.66	3.73
Forestry	0.00	0.00
Manufacturing	18660.29	14.44
Wood Products	2377.82	1.84
Industry	14473.64	11.20
Instrument & Equipment	6304.21	4.88
Electricity & Gas	3765.57	2.91
Trade	16750.75	12.96
Transportation	13327.76	10.31
Financial Services	37937.88	29.36
Education & Health Services	4800.87	3.72
Private & Non-profit Services	226.11	0.17
Entertainment	3848.54	2.98
Other Services	1937.18	1.50
Total Intermediate	129228.28	100.00

***Conclusion*:**

In conclusion, Malaysian timber products have become one of the major timber resources mainly for the production of timber sector within a decade. It is needed a success story-from a limited use timber to one which is in great demand by the wood based industry. This study considered the inter-linkages between the timber sector and other sectors in Malaysia's economy and calculated the economic impacts of output, income, value added, exports, imports, private consumption, government consumption, investment and the final demand. Using input-output model evaluated the economics impacts of Malaysia for this study. Timber sector such as forestry and wood products sector contributed in Malaysia's economic sector.

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