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The Regional Input-Output Model for East Malaysia Region: Construction and Application

Mohd Khairul Hisyam Hassan
Department of Economics, Faculty of Economics and Business, Universiti Malaysia Sarawak Malaysia

Zaleha Mohd Noor
Department of Economics, Faculty of Economics Management, Universiti Putra Malaysia Malaysia

Normaz Wana Ismail
Department of Economics, Faculty of Economics Management, Universiti Putra Malaysia Malaysia

Alias Radam
Department of Management, Faculty of Economics Management, Universiti Putra Malaysia Malaysia

Zakariah Abdul Rashid
Malaysian Institute of Economic Research, JKR 606, Jalan Bukit Petaling, P.O. Box 12160, Kuala Lumpur Malaysia

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ABSTRACT
This study examines the importance of regional development planning to economic growth through the construction of regional input-output table for East Malaysia. It is particularly important because only limited past studies have been conducted on the construction of regional input-output table at the regional or state level in Malaysia and also, the usage of input-output model has received much attention in many countries as a planning tool for economic development**.** In the case of East Malaysia, it was carried out through applying the non-survey based method, namely RAS technique. Through the backward and forward linkage and multipliers analysis, this study found that agriculture and livestock; mining and quarrying; food manufacturing; petroleum products; and electronics and non-electronics; sectors were among the sectors with the highest backward linkage and multiplier coefficients in the East Malaysia region. So, by putting additional investment into these sectors will generate more output to the overall economic performance of these regions because of the ability of these sectors to attract the other sectors in the economy.

Keywords: Regional; Input-Output Model; East Malaysia; RAS Technique; Multipliers

1. INTRODUCTION

In regional economic analysis, regional planning is an important effort to provide a useful tool for the development of a region, while regional development as the process of development in a particular area for future economic development and economic growth (Glasson, 1978). Meanwhile, Tjokroamidjojo (1990) mentioned that regional development process as a one of the holistic development approach of the region as a whole for future economic growth and development. In Malaysia, the objectives or goals of initiation of the regional economic development corridors, mainly concentrating on the reduction in cost of living and achieving the balanced socio-economic development across regions and states. This is in line with Robock (1966) which stated that the importance of regional development were improving the regional income disparities, achieving balanced regional growth and providing the special assistance to lower economic growth areas. So, systematic planning through the creation of employment, efficient economic management and the use of a new technology as well as having strategic locations for investors are amongst the main factors that contributed to the regional economic development in East Malaysia in the last decade. In year 2006, East Malaysia recorded growth of 4.8 per cent. The biggest contributor to its gross domestic product (GDP) was the resource-based sectors that included agriculture, and mining and quarrying, which contributed about 40.8 per cent. According to the Department of Statistics (2014), East Malaysia would have an economic growth rate at 2.5 per cent in 2012 which is slightly lower compared with 2006. Apart the reduction in East Malaysia's growth, the development in the main sectors of both regions need to be strengthened in order to give a conducive investment environment to the private sector for the high technology industry, diversification of exports and markets as well as the development of the support industry. As Malaysia has several state and local governments, by knowing this basic economic structure for East Malaysia, decisions in one state or district can have an impact throughout the whole country and state. Thus, the main purpose of this study is to construct the regional input-output table for East Malaysia for the year 2005. Input-output model at regional or state level would enable analysis to be carried out for smaller geographic areas with particular reference to the potential sectors in the economy that should be given more attention by the policymakers for the future economic growth in these regions (Saari and Rashid, 2009). The significant economic growth for East Malaysia has largely been due to the achievements of the resource-based sectors (especially mining and quarrying). The roles of mining and quarrying as major sector in the economic growth for East Malaysia can be seen from their increasing shares in the GDP and total export. However, for planning purposes, the large dependency for economic growth on the mining and quarrying sector for East Malaysia need regional input-output table. The construction of this table is important in understanding the economic structures of East Malaysia and determining the contribution of each sector to the economy. Generally, from this study, we could observe how the development of the major sectors for this region has impacted the other sectors in that region. Lastly, identifying the key sectors and multiplier effects in the economy through forward and backward linkages, output,

income and employment multipliers would provide a guide for the development planning for each region. The information on the effects of the major sectors on the least sectors contributing to the economic growth will be a significant useful policy guide for the planning purposes for East Malaysia. In the case of Malaysia as a whole, not many studies have been made to construct regional input-output table to use as tool for planning purposes. The paper is presented as follows. The next two sections present East Malaysia Economic Performance and the literature review, respectively. The fourth section explains the basic structure input-output table East Malaysia while the fifth section describes the methodology and data. The sixth section explains empirical results and the last section presents the conclusions and recommendations.

2. EAST MALAYSIA ECONOMIC PERFORMANCE

The economic development of East Malaysia has been defined mainly by the resource-based industry, particularly the mining and quarrying sector. But in 2007, the manufacturing sector became the dominant sector in contributing to the region's GDP. The annual growth rate for the manufacturing sector was recorded at 6.8 per cent, while the mining and quarrying and agriculture sectors recorded 2.5 per cent and 4.2 per cent respectively. However, the growth rates for other sectors showed steady figures at more than 9 per cent, i.e. wholesale and retail trade, hotel and restaurants (15.1 per cent); finance, insurance, real estate, and business services (13.1 per cent); transport, storage, and communication (9.4 per cent); and electricity, gas and water (9.3 per cent). Despite their growth rates of less than 5 per cent, construction; other services sector; and government services, still played an important role in contributing towards the GDP.

2.1 Economic Performance by Sector

2.1.1 Agriculture Sector

In East Malaysia, agriculture was for many years the second largest sector in production activities. This is shown by the contribution of this sector to the region's GDP in the early years. But starting from 2005, the importance of this sector to the state's GDP was taken over by manufacturing as the second largest contributor to the state's economy. During 2005, this sector recorded about RM16,925 million (19 per cent), increasing in years 2006 and 2007 to RM17,107 million (18 per cent) and RM17,820 million (18 per cent) respectively (Table 1).

Table 1 GDP by Economic Activity at Constant 2005 Prices-East Malaysia (RM million)

Economic Activity	2005	2006	2007
Agriculture	16,925	17,107	17,820
Mining and quarrying	20,626	21,441	21,976
Manufacturing	19,136	20,683	22,107
Electricity, gas and water	2,028	2,081	2,275
Construction	2,318	2,437	2,463
Wholesale and retail trade, hotels and restaurants	8,042	8,754	10,077
Transport, storage and communication	4,732	4,854	5,308
Finance, insurance, real estate and business services	7,013	7,389	8,398
Other services	3,339	3,429	3,560
Government services	5,613	6,011	6,225
Plus: Import duties	356	301	390
GDP at purchaser's prices	90,128	94,487	100,599

Source: Department of Statistics, Malaysia

2.1.2 Mining and Quarrying Sector

The mining and quarrying sector represents the largest economic activity in East Malaysia and provides a large contribution towards the region's GDP. This may be attributed to the rising production of petroleum and natural gas. During 2005, the GDP of East Malaysia contributed by mining and quarrying was RM20,626 million, 22.9 per cent of the total GDP (RM90,128 million). In 2006, the contribution of this sector decreased to 22.7 per cent (RM21,441 million) and then to 21.8 per cent (RM21,976 million) in 2007. This situation might have been caused by the expansion of the manufacturing sector as the largest contributor to the GDP in 2007 (Table 1).

2.1.3 Services Sectors

Services in East Malaysia are provided by six major sectors, i.e. wholesale and retail trade, hotels and restaurants; transport, storage and communication; finance, insurance, real estate and business services; government services; and other services. In 2005, the biggest services sector that contributed to the region's GDP was wholesale and retail trade, hotels and restaurants which recorded 8.9 per cent (RM8,042 million) of the total GDP. The contribution of this sector increased to 9.3 per cent (RM8,754 million) in 2006, and further increased to 10 per cent in 2007 (RM10,077 million) (Table 1).

2.1.4 Industrial Sectors

Three sectors are classified as industrial sectors, i.e. manufacturing; construction; and electricity, gas and water. These sectors work together to drive the region's economy, with the manufacturing sector being one of the main contributors to the region's GDP. In 2005, the manufacturing sector ranked second place recording 21 per cent (RM19,136 million) and

increasing to 22 per cent in 2006 (RM20,683 million). In 2007, this sector regained its pole position in the state's GDP at 22 per cent (RM22,107 million) (Table 1.3). The GDP of East Malaysia at constant market prices by industrial origin from 2005 to 2007 is shown in Table 1.

3. LITERATURE REVIEW

The construction of regional input-output table involves the common issues in regional economics research in recent years, particularly in theory (spatial price theory, location theory, and regional growth theory), method (economic bade models, regional input-output models, regional econometric models, shift-share analysis and gravity models), and policy as stated in Richardson (1978). These three elements are the important parts in generating the regional input-output coefficient such as using the national table as a control (non-survey based method), survey-based method, and hybrid model (mixed survey-based method and non-survey based method). He also mentioned the difficulties in solving the problems in regional economics such as inter-regional macroeconomic model, migration and some techniques in regional analysis. According to Oosterhaven (1980), regional input-output table compiling corresponds to usual input-output practices. Again, regional and inter-regional input-output analyses are very useful tools for all sorts of economics studies in regional level, particularly in estimating the economic impacts, full regional forecast model, experiments with programming model, and much more. This is supported by Jensen and Macdonald (1982) who said that regional input-output results from the application of input-output at national level and is strongly a useful tool in government planning. For the purpose of planning of regional economies, regional input-output tables are very important to identify the new or old sectors that influence the expansion of the economic growth for the regions. This also includes the infrastructure requirements needed by the sectors. In another major study, Jensen (1990) discussed the development of the regional input-output table from the classical era (survey-based method) to the modern era of the growth (ready-made models) through technological change.

Hence, the attempts to construct regional input-output tables using various methods of estimation, namely survey-based method, non-survey based method and hybrid model (mixed of survey-based method and non-survey based method), were made for planning purposes. Normally, survey-based methods attempt to determine the elements of the transaction table collections of primary data by various survey-based methods and then using the methods of modifications to derive these elements from national tables. The non-survey based methods need the national tables as a basic structure to construct the regional input-output tables using the regional data. Several alternatives of non-survey based methods have been used in the construction of regional input-output tables. Most empirical studies on the construction of regional coefficients used the non-survey based method because conducting a survey with the necessary details is very expensive and time consuming; nowadays, the survey-based method is rarely used. The non-survey-based method uses the input-output table at national level to produce a regional table and assumes that the regional and national technologies are the same. In general, there are several non-survey-based methods used by researchers to construct or

develop a regional input-output table for a particular region. Hewings (1969) examined the several methods of using the national input-output table at regional level for the West Midlands region of the United Kingdom. The result showed that all three methods gave about the same result of intermediate sales which was not very convincing and the variations in the column multipliers suggested that focus must be given to the variations in interindustry purchases. In a different study, Hewings (1984) used the State of Washington input-output models for 1963, 1967 and 1972 to highlight the role of error in an input-output model nested within a social accounting framework.

With a different non-survey-based method, Gerking (1976) used input-output data from West Virginia to conduct an experiment reconciling rows only and columns only in estimating regional coefficient for the single input-output table. As regards Miernyk's (1976) comment, the minimum variance estimates were introduced only to present an alternative solution to the reconciliation problem. In a different view, the main reason in introducing the minimum variance procedure was to avoid the misinformation each was likely to provide, and the reconciled estimates would always be smaller than the estimation for either rows only or columns only elements. In addition, Gerking (1979) extended the works on the reconciliation of regional coefficients in input-output models to incorporate the major information in the minimum variance process. In Malaysia, regional input-output analysis is rarely done. But there have been a few studies on the regional problems. For instance, Noor (1996) used LQ to estimate the input-output table for Sarawak. He estimated the framework for relevant sectors (21 sectors), introduced the element of supply constraints in the harvest by the forestry sector into the input-output model and estimated the impact of reallocating the timber market between export and domestic demand. A more recent study of the construction of a regional input-output model was done by Saari and Rashid (2009) using the non-survey-based method in estimating the regional input-output table for Selangor in 2000. They estimated the unavailable of data using the LQ approach and then proceeded to the RAS procedure to estimate Selangor's input-output table for relevant sectors (58 sectors). Moreover, they also estimated the linkages effect, and analysed the impact (output, import, value added and non-direct taxes). They found that the manufacturing sector was the main contributor to Selangor's economy. The main sub-sectors that contributed most to the economic growth in Selangor were electronics and electrical appliances, non-electrical appliances and motor vehicles. Apart from that, they also created a basic framework for Selangor's GDP using the System of National Account (1993) through the expenditure and production methods.

4. BASIC STRUCTURE INPUT-OUTPUT TABLE EAST MALAYSIA

The basic structures of the regional input-output table for East Malaysia are similar to that of the national table. The first quadrant or intermediate demand quadrant is represented by the matrix of 20 industry rows and columns. This quadrant shows the transaction of the productive sector to buying and selling all the intermediate inputs. The second quadrant (final demand) is represented by 20 industry rows and five columns of final demand sector (private consumption, government consumption, change in inventory, gross fixed capital formation and exports). This

final demand shows sale of industry output to final end use of goods and services. Quadrant three is the primary quadrant which includes taxes, import and value added. This quadrant is represented by 20 industry columns and six primary sectors. The fourth quadrant comprises six rows of primary input sector and five columns of final demand sector.

Table 2 Structure of Single-Region Input-Output Table for East Malaysia

			Intermediate demand								Final demand							
															Export			
			1	.	.	j	.	.	20	Total intermediate demand	Private consumption	Government consumption	Change in inventory	Gross fixed capital formation	Foreign	Inter-regional	Total final demand	Total output
Intermediate demand		1	Quadrant 1 Intermediate demand								Quadrant 2 Final demand							
		.																
		.																
		i																
		.																
		.																
		20																
		Total intermediate demand																
Primary inputs		Purchases from abroad	Quadrant 3 Primary inputs								Quadrant 4 Primary inputs to final demand							
		Domestic Services																
		Taxes of commodity (import)																
		Taxes of commodity (domestic)																
	Import	Foreign																
		Inter-regional																
		Value added																
		Total primary inputs																
		Total inputs																

Notes: 1=Agriculture and livestock, 2=Forestry and logging, 3=Fisheries, 4=Mining and quarrying, 5=Food manufacturing, 6=Sawmill products, 7=Furniture and fixtures, 8=Chemical products, 9=Petroleum product, 10=Electronics and non-electronics, 11=Motor vehicles and other transport, 12=Other manufacturing, 13=Electricity, gas and water, 14=Construction, 15=Wholesale and retail trade, 16=Hotels and restaurants, 17=Transport, storage and communication, 18=Finance, insurance, real estate and business services, 19=Other services, and 20=Government services.

Source: Miller and Blair (2009)

5. METHODOLOGY AND DATA

The construction of a regional input-output table using survey-based method needs data from survey to calculate the supply and use tables, and later to derive a regional input-output table. This is basically the method to develop a national input-output table. However, to construct a regional input-output table, there is a need for some modification to be made for the different

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information of a certain account. Since conducting a survey with the necessary details is extremely expensive, the pure survey-based method is rarely used nowadays. Instead, non-survey based method and hybrid model have become popular. In this study, the construction of regional input-output table for East Malaysia used the non-survey method. The main sources of data were taken from the Departments of Statistics, Malaysia, Sarawak and Sabah for the development of the regional input-output tables with the national input-output table used as a reference. So, in constructing the regional input-output models with the most accurate figures, some sectors needed the full range of superior data, especially for the key sectors (Lahr, 1993).

5.1 RAS Technique

The RAS or biproportional method was originated and developed by Professor Stone and his colleagues at Cambridge during the early sixties. The RAS method is one of the non-survey based methods to estimate the regional input-output coefficient and was used to produce the regional input-output table for the East Malaysia region. In this study, we applied the model used by Saari and Rashid (2009). This method can be explained by the following equation:

$$A^* = RAS \tag{1}$$

where A is direct input-output coefficient matrix at national level, R and S are diagonal matrices of row and column constraints, and A^* is an estimated direct input-output coefficient at state level. Matrix A^* of state direct coefficient matrix in equation (1) is formed as a result of pre-and post-multiplication of a matrix with a diagonal matrix.

This implies that each element a^*_{ij} matrix A^* obtained from any element a_{ij} matrix A as the following equation:

$$a^*_{ij} = r_i \; a_{ij} s_j \tag{2}$$

Since equation (2) shows all the elements of the matrices A and A^* are the same, then the dimensions of the two matrices are also similar. Each element of R must be equal to the number of lines A and A^*, while the number of columns A and A^* determine the number of elements of S. In each row of the RAS technique, elements R and a^*_{ij} are formed by multiplying each element of row i matrix A by the same R factor. When all operating lines for matrix A are finished, they will produce a matrix B:

$$B = R\,A \tag{3}$$

or equivalent:

$$b_{ij} = r_i \; a_{ij} \tag{4}$$

The last process to form the matrix A^* is multiplying every element j column of the matrix B by each element of column j factor S. This will produce a matrix BS,

$$BS = R \quad A \quad S \quad = \quad A^* \tag{5}$$

where,

$$a^*_{ij} \quad = c_{ij}s_j = \quad r_i \quad a_{ij} \quad s_j \tag{6}$$

5.2 The Rasmussen Unweighted Approach

In Leontief demand-driven model, the backward linkages represent the total input requirements for a unit increase in the final demand for a particular sector *j* and is defined as:

$$BL_j = \sum_{i=1}^{n} a_{ij}$$
$$= b_j^* \tag{7}$$

where BL_j is the backward linkages of sector *j* of Rasmussen unweighted method, a_{ij} is the element of Leontief inverse matrix, *n* is the number of sectors, and b_j^* is the sum of the column element in sector *j*.

Apart from that, Rasmussen (1956) termed the backward indices as the power of dispersion index. Coefficient of dispersion shows the dependence of a particular sector on other sectors in a regional economy. The power of dispersion index is defined as:

$$U_j = \frac{\frac{1}{n} b_{j*}}{\frac{1}{n^2} \sum_{j=1}^{n} b_{j*}} \tag{8}$$

In the Ghosh supply driven model, the forward linkages represent the row sums of the elements of the Ghosh inverse matrix and are shown below:

$$FL_i = \sum_{j=1}^{n} z_{ij}$$
$$= b_i^* \tag{9}$$

where FL_j is the forward linkages of sector *i* of Rasmussen unweighted method, z_{ij} is the element of Ghosh inverse matrix, *n* is the number of sectors, and b_i^* is the sum of the row element in sector *i*.

This is also known as sensitivity of dispersion that shows forward linkage or support from a particular sector to other sectors. The sensitivity of dispersion index is defined as

$$U_i = \frac{\frac{1}{n} b_{i*}}{\frac{1}{n^2} \sum_{i=1}^{n} b_{i*}} \tag{10}$$

5.3 The Rasmussen Weighted Approach

The weights for backward linkages are the shares of sectors in final demand components and weights for forward linkages are the primary input components (value added). Basically, the measurement of weighted average is to take into account the importance of each sector in terms of final demand and primary inputs. If weighted Leontief inverse elements are based on final demand, then

$$a_{ij}^{w} = a_{ij} \frac{F_i}{\sum_{i=1}^{n} F_i} \tag{11}$$

where a^w_{ij} is the weighted element of Leontief inverse matrix, a_{ij} is the element of Leontief inverse matrix, and F_i is the final demand components. Similarly, if the weight is based on value added, then

$$z_{ij}^{w} = z_{ij} \frac{V_i}{\sum_{i=1}^{n} V_i} \tag{12}$$

where z^w_{ij} is the weighted element of Ghosh inverse matrix, z_{ij} is the element of Ghosh inverse matrix, and V_i is the value-added components. Therefore, the equations for weighted backward and forward linkages are given as:

$$BL_j^{w} = \sum_{i=1}^{n} a_{ij}^{w}$$

and

$$= b_j{}^{*w} \tag{13}$$

$$FL_j^{w} = \sum_{j=1}^{n} z_{ij}^{w}$$

$$= b_i{}^{*w} \tag{14}$$

Using the normalizing approach, the weighted backward and forward indices are given as:

$$U_j^w = \frac{\frac{1}{n} b_{j*}^w}{\frac{1}{n^2} \sum_{j=1}^{n} b_{j*}^w}$$

and (15)

$$U_i^w = \frac{\frac{1}{n} b_{i*}^w}{\frac{1}{n^2} \sum_{i=1}^{n} b_{i*}^w} \quad (16)$$

5.4 Multipliers Analysis

The basic input-output model is useful in explaining any changes in the demand for the regional economy through the multiplier effects. Input-output multiplier is derived from input-output table on various economic variables including gross domestic product (GDP), employment, output, salary and wages, etc. There are three kinds of multipliers, namely output multiplier, income multiplier and employment multiplier. For instance, if the household sector is considered a factor that is out of the model or exogenous factor, it will produce simple multiplier or type I multiplier. For this type, the open inverse matrix of Leontief is used to show the direct effect of spending in a particular industry as well as the indirect effects of the multiplier. On the other hand, if the household sector becomes an endogenous factor, it will increase the total multiplier and this is called type II multipliers. This type II multiplier uses the closed Leontief inverse matrix (Miller and Blair, 2009).

5.4.1 Output Multipliers

The simple output or type I multiplier for a particular sector is defined as the total amount of production in all sectors of the whole economy that is necessary in order to satisfy a dollar's worth of final demand for sector *j*'s output. The measurement of value for simple output multiplier of a sector is given by the formula;

$$MX_j = \sum_{i=1}^{n} b_{ij} \quad (17)$$

where MX_j is a simple output multiplier for sector *i* and b_{ij} is an element in the Leontief inverse matrix (regional).

5.4.2 Primary Input Multipliers

Basically, primary input multipliers consist of value-added multiplier, import multiplier and taxes multiplier (domestic and import). These multipliers show the changes in the value-added, import and taxes (domestic and import) of all sectors due to per unit increase of final demand

in a particular sector. The primary input multipliers are obtained by using the following equation:

$$MP_j = \sum_{i=1}^{n} c_i b_{ij} \quad (18)$$

where MP_j is a simple primary input multiplier for sector i, b_{ij} is an element in the Leontief inverse matrix (regional) and c_i is a share of primary input components (value-added, import and taxes) for sector i.

5.4.3 Employment Multipliers

The simple employment multiplier explains the amount of employment generated in the region for each additional ringgit of final demand for the sector's output. This is useful for policymakers or economists to see the employment impacts of a particular sector expansion in their region. The measurement for the employment multiplier is shown as follows:

$$ME_j = \sum_{i=1}^{n} E_{n+1,i} b_{ij} \quad (19)$$

where ME_j is a simple employment multiplier sector j, E_{n+1},i is a employment coefficient sector i and b_{ij} is an element in the Leontief inverse matrix (regional).

5.5 Data

The dataset in this study includes mainly two categories. The first set of data is on regional input-output, which enables one to explore the flows of goods and services between producers and consumers and inter-relationships between all economic sectors in a region. In the final demand side, the data are on private consumption, government consumption, gross fixed capital formation, change in inventory and export taken from annual national accounts of Malaysia and Sarawak, and also various types of survey published by the Department of Statistics, Malaysia (DOSM). On the other hand, the primary input data components were also taken from the same sources. These components include domestic taxes, import taxes, import and value added. The other data such as salary and wages, employment, export and import by destination, inter-regional export and import were from Economic Reports, Yearbooks of Statistics, Malaysia and Sarawak, and External Trade Statistics, Malaysia and Sarawak, published by the DOSM and also Department of Statistics, Sarawak (DOS Sarawak). The second set of data used Malaysia's input-output table for 2005 published by the Department of Statistics, Malaysia and perhaps gives the most accurate information about the interindustry relations and structure of the economy.

6. EMPIRICAL RESULTS

In general, the value of the total output generated in East Malaysia for year 2005 amounted to RM207,431 million, mainly dominated by the resource-based sectors. Mining and quarrying was viewed as the most important sector in generating the total output for East Malaysia with the total output value of RM46,125 million in 2005, representing 22.2 per cent of the overall total output in the economy. The main activities in this sector that contributed most to the total

mining and quarrying's output were crude petroleum and natural gas. On the other hand, other sectors also showed significant contribution to the overall total output in East Malaysia behind the mining and quarrying sector. For instance, wholesale and retail trade contributed about RM29,334 million (14.1 per cent), agriculture and livestock (10.0 per cent), chemical products (7.0 per cent) and government services (6.0 per cent). At the same time, several sectors only recorded less than 5 per cent to the overall total output in East Malaysia such as sawmill products; transport, storage and communication; and petroleum products (Table 3).

Table 3 Contribution of Each Sector to the Gross Outputs in East Malaysia, 2005

Sector	East Malaysia	
	RM million	Percentage (%)
Agriculture and livestock	20,677	10.0
Forestry and logging	6,243	3.0
Fisheries	2,356	1.1
Mining and quarrying	46,125	22.2
Food manufacturing	7,149	3.4
Sawmill products	9,580	4.6
Furniture and fixtures	1,686	0.8
Chemicals products	14,596	7.0
Petroleum products	7,916	3.8
Electronics and non-electronics	4,039	1.9
Motor vehicles and other transport	7,735	3.7
Other manufacturing	5,276	2.5
Electricity, gas and water	4,670	2.3
Construction	6,017	2.9
Wholesale and retail trade	29,334	14.1
Hotels and restaurants	1,998	1.0
Transport, storage and communication	9,141	4.4
Finance, insurance, real estate and business services	5,781	2.8
Other services	4,668	2.3
Government services	12,444	6.0
Total	207,431	100.0

Source: Input-output table of East Malaysia, 2005

The unweighted and weighted sectoral indices of backward and forward linkages are obtained by using equations (8) and (10) and equations (15) and (16) respectively. The results of this analysis are shown in Tables 4 (unweighted approach) and 5 (weighted approach). By using the unweighted approach for the single-region input-output model, East Malaysia recorded four key sectors, i.e. agriculture and livestock; food manufacturing; electricity, gas and water; and transport, storage and communication.

Table 4 Backward and Forward Linkages in East Malaysia (Rasmussen Unweighted Approach), 2005

Sector	East Malaysia			
	Backward linkages		Forward linkages	
	Index	Rank	Index	Rank
Agriculture and livestock	1.1341	6	1.2640	4
Forestry and logging	0.6437	19	0.9579	11
Fisheries	0.9199	12	1.1679	6
Mining and quarrying	0.9129	14	0.4927	20
Food manufacturing	1.2228	4	1.4219	3
Sawmill products	1.1070	7	0.6867	17
Furniture and fixtures	1.5087	1	0.9223	13
Chemicals products	0.9290	11	1.2350	5
Petroleum products	0.6585	18	1.1029	8
Electronics and non-electronics	0.8139	16	0.6226	18
Motor vehicles and other transport	0.8451	15	1.5177	2
Other manufacturing	0.9763	10	1.0577	9
Electricity, gas and water	1.2932	3	1.6263	1
Construction	1.1879	5	0.7150	16
Wholesale and retail trade	1.3952	2	0.9724	10
Hotels and restaurants	0.9155	13	0.7492	15
Transport, storage and communication	1.0776	9	1.1296	7
Finance, insurance, real estate and business services	0.5694	20	0.8916	14
Other services	0.7888	17	0.9388	12
Government services	1.1004	8	0.5282	19

Source: Input-output table of East Malaysia, 2005

On the other hand, Table 4 gives the weighted approach coefficients for East Malaysia region. Agriculture and livestock, mining and quarrying, and wholesale and retail trade were the key sectors that showed strong backward and forward linkages (more than 1) in East Malaysia. In summary, these foregoing most strategic sectors had high potential in generating output for East Malaysia. Policymakers need to pay more attention to these sectors with high contributions to output purchasing and buying in these two regions. So any additional output to the final demand in these sectors, for example additional investment, would generate output for all sectors in the economy.

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Table 5 Backward and Forward Linkages in East Malaysia (Rasmussen Weighted Approach), 2005

Sector	East Malaysia			
	Backward linkages		Forward linkages	
	Index	Rank	Index	Rank
Agriculture and livestock	1.4126	4	3.2742	2
Forestry and logging	0.2802	18	1.2577	5
Fisheries	0.2376	19	0.3848	13
Mining and quarrying	5.3859	1	4.4746	1
Food manufacturing	0.8262	9	0.6582	11
Sawmill products	1.1641	5	0.5539	12
Furniture and fixtures	0.8641	7	0.0629	19
Chemicals products	0.8484	8	2.7259	3
Petroleum products	0.5884	12	0.0637	18
Electronics and non-electronics	0.6680	11	0.1345	17
Motor vehicles and other transport	0.1324	20	0.0514	20
Other manufacturing	0.5842	13	0.2192	15
Electricity, gas and water	0.5002	14	0.6637	10
Construction	1.0789	6	0.2620	14
Wholesale and retail trade	1.8508	2	1.1656	7
Hotels and restaurants	0.3319	17	0.1543	16
Transport, storage and communication	0.6725	10	1.1831	6
Finance, insurance, real estate and business services	0.3522	16	1.3128	4
Other services	0.4543	15	0.7260	8
Government services	1.7671	3	0.6712	9

Source: Input-output table of East Malaysia, 2005

Table 6 shows the values of sectoral output multipliers based on the East Malaysia input-output table. By using the single-region input-output model, East Malaysia recorded the furniture and fixtures sector as having the highest output. This means that increasing a unit of the final demand would increase the output multipliers of the furniture and fixtures by 2.8438. These values of output generated in the economy included direct effects on its own sectors and interactions with other sectors in the economy as well. The wholesale and retail trade; and electricity, gas and water; sectors were the second and third sectors in East Malaysia with the highest output multipliers of 2.6298 and 2.4375 respectively. The furniture and fixtures; wholesale and retail trade; and electricity, gas and sectors recorded the highest output

multiplier values in the East Malaysia region because these sectors had strong input relations with the other sectors in the economy as shown by values of their backward linkages.

Besides the output multipliers, this study also estimated the primary input multipliers in East Malaysia consisting of value added, import (foreign and inter-regional import) and taxes (domestic and import) multipliers which are among the main sources of revenue for the state governments. Primary input multipliers means increasing or decreasing values in value added, import (foreign and inter-regional) and taxes (domestic and import) due to increase in final demand for a particular sector. Basically, the values for these multipliers are always less than 1. Import multiplier is the important variable in the economy to highlight the value of leakages for each unit of final demand produced by productive sectors in the economy and trade balance for any increase in final demand for different sectors. The values of import multipliers (foreign and inter-regional import) that were estimated for East Malaysia using the single-region model show that the petroleum products sector with value of 0.8545 had the highest value compared with the other sectors in the economy. Other sectors such as motor vehicles and other transport, electronics and non-electronics, other manufacturing, hotels and restaurants, and construction sectors produced import multiplier coefficients (foreign and inter-regional import) of 0.6997, 0.6191, 0.5341, 0.3746 and 0.3538 respectively.

For the value added, the finance, insurance, real estate and business services sector recorded the highest value added multiplier in East Malaysia with value of 0.9079. This shows that any increase in the final demand of these sectors would lead to a big generation of value added in the East Malaysia region. The agriculture and livestock sector ranked second with value of 0.8707, followed by the mining and quarrying sector in the third rank with value of 0.8608 in the East Malaysia region. These three sectors had the highest values of multipliers (value added) because of their capability in generating high values for value added while using low input from the imported raw materials compared with the other sectors in the economy. For domestic taxes multipliers, the motor vehicles sector recorded the highest value for East Malaysia with coefficient of 0.2010, while the forestry and logging sector recorded the highest import taxes multipliers for East Malaysia with values of 0.0338. This indicates that these sectors were among the main contributors to the government revenue from the East Malaysia regions through indirect taxes in 2005.

Employment multiplier is another important measurement in addition to output and primary multipliers. An employment multiplier shows the amount of employment generated in the region for each additional ringgit of final demand for the sector's output. This measurement is one of the important tools used by policymakers to estimate changes in jobs in a particular region or area. For the purpose of this study, analysis of the Type I employment multipliers was focused on the main sectors for East Malaysia. The employment multipliers for the 20 sectors in East Malaysia for the year 2005 are given in Table 6. The hotels and restaurant sector had the highest employment multiplier with value of 0.0587 in East Malaysia. So, increasing a unit of final demand in these sectors would increase 0.0587 in the East Malaysia region. The

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construction sector had the second highest employment multiplier in East Malaysia with value of 0.0406, followed by the government services (0.0362), agriculture and livestock (0.0343), forestry and logging (0.0333), fisheries (0.0326), and wholesale and retail trade (0.0271) sectors. All the sectors mentioned were among the important sectors in East Malaysia in generating high employment. Based on these figures, it can be seen that the petroleum products, and motor vehicles and other transport sectors presented the smallest employment multipliers with values of 0.0022 and 0.0017 respectively. This shows that these sectors had less potential to create more employment in East Malaysia.

Table 6 Output, Value-Added, Import, Domestic Tax, Import Duties, and Employment Multipliers in East Malaysia, 2005

Sector	East Malaysia						
	Output	Value-added	Import		Domestic tax	Import duties	Emp*
			Foreign	Inter-regional			
Agriculture and livestock	2.1377	0.8707	0.0497	0.0696	0.0072	0.0028	0.0343
Forestry and logging	1.2133	0.7486	0.0674	0.1287	0.0215	0.0338	0.0333
Fisheries	1.7339	0.8016	0.0784	0.1096	0.0095	0.0008	0.0326
Mining and quarrying	1.7207	0.8608	0.0513	0.0720	0.0114	0.0045	0.0074
Food manufacturing	2.3048	0.6910	0.1197	0.1675	0.0171	0.0047	0.0207
Sawmill products	2.0865	0.7875	0.0687	0.1117	0.0147	0.0174	0.0236
Furniture and fixtures	2.8438	0.6803	0.1050	0.1526	0.0371	0.0249	0.0196
Chemicals products	1.7511	0.8097	0.0717	0.1005	0.0124	0.0057	0.0157
Petroleum products	1.2413	0.1134	0.3563	0.4982	0.0063	0.0257	0.0022
Electronics and non-electronics	1.5342	0.3303	0.2581	0.3610	0.0307	0.0199	0.0081
Motor vehicles and other transport	1.5930	0.0710	0.2918	0.4080	0.2010	0.0282	0.0017
Other manufacturing	1.8402	0.4150	0.2226	0.3116	0.0316	0.0193	0.0099
Electricity, gas and water	2.4375	0.6719	0.1242	0.1738	0.0210	0.0091	0.0086
Construction	2.2390	0.6009	0.1465	0.2073	0.0290	0.0163	0.0406
Wholesale and retail trade	2.6298	0.6412	0.1253	0.1759	0.0456	0.0119	0.0271
Hotels and restaurants	1.7257	0.6036	0.1562	0.2184	0.0175	0.0043	0.0587
Transport, storage and communication	2.0312	0.7608	0.0877	0.1227	0.0207	0.0081	0.0193
Finance, insurance, real estate and business services	1.0732	0.9079	0.0306	0.0428	0.0105	0.0082	0.0147
Other services	1.4867	0.8087	0.0635	0.0888	0.0359	0.0031	0.0267
Government services	2.0742	0.6777	0.1209	0.1694	0.0253	0.0067	0.0362

Note: Emp* = Employment

Source: Input-output table of East Malaysia, 2005

7. CONCLUSIONS AND RECOMMENDATIONS

This study provided the regional input-output table for East Malaysia in 2005 basic year using the non-survey-based method, namely RAS technique. In general, the RAS technique was used to estimate the supply and demand flows between sectors in the economy (quadrant I), while the other flows or quadrants (II, III, and IV) were estimated using the real data provided by various departments or agencies. Basically, these methods assume that the structures of input and technology used in East Malaysia are identical with the technology at the national level. The result show that the overall East Malaysia recorded RM207,431 million (62 per cent) from its productive sectors, while the rest of the output was contributed by the unproductive sectors such as households and government consumption. The mining and quarrying sector was the highest contributor to the output generation in East Malaysia with value of RM46,125 million. The wholesale and retail trade sector was ranked second amounting to about RM29,334 million, followed by the agriculture and livestock sector in the third rank with output generated at about RM20,677 million. By using the single-region model (Rasmussen unweighted and weighted approaches), East Malaysia recorded six key sectors (agriculture and livestock; mining and quarrying; food manufacturing; electricity, gas and water; wholesale and retail trade; and transport, storage and communication). So, putting additional investment into these sectors would generate more output to the overall economic performance for this region because of the ability of these sectors to attract the other sectors in the economy. Lastly, through analysis of the multipliers using the single region model, the agriculture and livestock; food manufacturing; sawmill products; furniture and fixtures; electricity, gas and water; construction; wholesale and retail trade; government services; were among the sectors with high multiplier values in East Malaysia. Additional units in final demand for these sectors would create high values of output, value added, import, domestic tax, import duties and employment in this region. The values of multipliers were estimated based on input-output analysis and included the direct and indirect effects due to exogenous variable changes in these regions. Therefore for planning purposes, the authorities in East Malaysia need to provide good facilities and incentives to attract more foreign investors to set up their operations in these regions, particularly in the sectors, agriculture and livestock, mining and quarrying, food manufacturing, petroleum products, and electronics and non-electronics sector. This will indirectly increase employment opportunities for local workers and lower the unemployment rate.

Corresponding Author
Mohd Khairul Hisyam Hassan
Faculty of Economics and Business, Universiti Malaysia Sarawak (UNIMAS)
Email: hmkhisyam@unimas.my

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