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Ranking Sectors Changes of the Malaysian Economy: Input-Output Approach

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Abstract

This study attempts to re-investigate the production structure change for Malaysia economy through the ranking sectors changes over the period 1983-2000. We used four input-output tables had published so far by Department Statistics of Malaysia (DSOM) for the period under study. The study employed the Leontief model for demand side (Input inverse $(\underline{I}\text{-}\underline{A})^{-1}$) for forward linkages indices, while supply side (Output Inverse, $(\underline{I}\text{-}\underline{O})^{-1}$) for backward linkages indices to examine the ranking sectors structure changes. New evidence is found in this study: first, the integration degree between demand and supply side for the Malaysian economy still remain weak. Second, the rank correlation coefficients between forward and backward indices are not significant and very weak. Third, the linkages between the commodities sectors and the rest of the economy still remain weak. Fourth, there is still a high dependency on the primary sectors, such us Oil palm, Rubber primary products and Wood sectors. Finally, fifth, the main results of the development policies were to transform Malaysia from an exporter to an importer foodstuff and other agriculture products.

Keywords: Input-output Model, Input Coefficient, Output Coefficient, Backward Linkage, Forward Linkage, Key Sector

1. Introduction

One of the objectives all less developed countries have set themselves is rapid growth in income per head. Rising incomes are associated in both time-series and cross-section studies with a rising share of industry in gross domestic product (GDP) [BULMER-THOMAS, 1982].

The development process can be carried out in a number of ways, but each new industrial investment will offer opportunities for other suppliers (backward linkages) and provide input for utilisation by other users (forward linkages). Furthermore, these backward and forward linkages are not reflected in market prices and therefore represent externalities, which could cause the social benefits of investment to diverge from the private benefits [BULMER-THOMAS, 1982; p.190]. It might appear, therefore, that by concentrating on those sectors with high backward or forward linkages, the development process could be speeded up. If, furthermore, we were prepared to assume [HIRSCHMAN, 1958; p.102] common techniques across countries for each sector, a common set of relative prices and a distribution of income consistent with the eventual emergence in each less developed country of the structure of demand to be found in developed countries, then we could select our key industrial sectors for promotion by reference to the backward and forward linkage found in developed countries.

The average backward and forward linkage indices are greater in the developed countries than those in the less developed countries, and the indices of the coefficients of variation are lower in the developed countries than in the less developed countries, presumably revealing a lower level of integration of these economy's industries [BOUCHER, 1976; P.318].

We shall argue below that these assumptions are too strong and that the ranking of sectors or investments in terms of linkages in this way is not a very satisfactory guide to development planning. However, first we must show how we might measure such linkages using input-output tables for the Malaysian Economy, for it should be clear that such tables offer an excellent opportunity to quantify a concept which would otherwise remain empirically intractable [BULMER-THOMAS, 1982; P.192]. The structural linkage of sectors can be described by two types of linkage effects, which can be measured in the framework of technology matrices. These linkage effects are the backward linkage effect and the forward linkage effect.

Before reviewing the theoretical basis of the linkage argument, two important points should be noted.

First, measures of linkage should not be confused with sectoral (income or employment) multipliers. Sectoral multipliers are designed to measure the impact of an increase in final demand on income or employment [BEKHEET, 2009]. Measures of linkage are designed to assess the impact of an increase in final demands on gross outputs. A high value for backward or forward linkages does not imply a correspondingly high value for the income or employment

multipliers, a point overlooked by some writers who seem to assume that high linkages mean a high domestic value-added content. For the above reason I will study the multipliers in a separate paper [BEKHET, 2010].

Secondly, it is important to distinguish between measures of linkage based on the existing technology of a economy's structure of production, and measures of linkage based on the existing interdependence of domestic sectors of production. In the latter case, backward and forward linkages measure the impact of a unit increase in final demand on domestically supplied inputs and outputs, and the appropriate matrix for calculating linkages is $(\underline{I}-\underline{A}_d)^{-1}$, where $\underline{A}_d$ is the matrix of domestic transaction coefficients. In the former case, measures of linkage are based on the technology matrix $(\underline{I}–\underline{A})^{-1}$, where $\underline{A}$ is the matrix of total (domestic plus imported) transaction coefficients. Hence, in this case, backward and forward linkages measure the impact of a one unit increase in final demand on total supply, rather than gross output, In this study, I will be using the technology matrix $(\underline{I}–\underline{A}_d)^{-1}$, because the imports coefficients are not available for all the Malaysian input-output tables [Department Statistics Of Malaysia, 2009].

The subsequent nine sections of this paper are structured as follows. Section 2 deals with the problem and objectives of the paper. Section 3 deals with the definitions of the input coefficients matrix, $\underline{A}$, and output coefficients matrix, $\underline{O}$. Section 4 deals with the interpretation of the input Leontief inverse, $(\underline{I}–\underline{A})^{-1}$ and the output Leontief inverse, $(\underline{I}–\underline{O})^{-1}$. Section 5 examines with backward linkages and forward linkages. Section 6 gives empirical results of the linkage indices for the Malaysian economy. Section 7 offers some policy implications. In Section 8 some concluding remarks are made.

2. The problem and objectives of the Analysis:

2.1 The problem

In Malaysia, as in most resources-rich developing countries, the availability of foreign exchange generated by the rapidly growing export of resources has been of great importance to the process of economic development. The aim of Malaysia development policy has been, primarily, to invest in the commodities sectors. The rationale behind this policy was to build a solid base for the Malaysian economy; by using the resources revenues (such as Crude Oil, Mining & Quarrying, Palm Oil, and Rubber products) to support the establishment of large scales enterprises, which could produce intermediate products at competitive prices for the other industries in the economy. This would thus aid the integration of the national economy. Secondary aims were to assist in income redistribution, import substitution, export growth and agricultural modernization.

Unfortunately, such a policy of inter-sectoral imbalance between economic sectors has lead to a poorly integrated economy in the short-run, causing a heavy dependence on imports. The presently existing weak forward and backward linkages between sectors are cited among the problems existing in the Malaysian economy.

In addition, the planners' policy towards the industrial sector regarding the adoption of advanced technology has resulted in production below its potential maximum in the short-run. This is because a number of structural "bottlenecks" developed, such as an insufficiently trained labour force and a lack of managerial and technical skills, as well as a heavy bureaucratic and hierarchical structure of organisation.

2.2 Objectives of the Analysis:

This study aims to assess the success or failure of Malaysian economic policy with input-output analysis. A static input-output model is used. Unfortunately, dynamic input-output models must be ignored, as the necessary capital matrix is not available for the Malaysian economy. The period of study is 1983-2000, during which time four input-output tables were established. The year 2000 is chosen as the closing year of study because this is the last year for which an input-output table is available.

It would be expected that in resources-rich developing economy, such as that of Malaysia, substantial structural change will take place over time. In particular, one might expect marked changes in the technologies employed, especially the nature of inter-industry trading. Also, change in the level and mix of final demand for produced goods would be expected to occur. One would anticipate that the role of state economic planning would be to facilitate and direct such developments.

Input-output analysis is well suited to the analysis of the nature of economic development through changing demand and changing technology. There are so many input-output techniques we can use to explore the ranking change of the sectors, such as linkages, multipliers, matrix triangularsation. Thus this study uses one of these techniques of input-output methods to explore the structural change of the Malaysian economy which is linkages analysis. It leads towards the conclusion that economic integration has occurred in Malaysia during the period of study. Also, there is evidence of increasing efficiency in the Malaysian economy. However, there remain substantial benefits from further integration which economic plans thus far have not exploited.

3. The Input Coefficients Matrix and the Output Coefficients Matrix

The input-output model describes two aspects of the relationships among participants in the production process. It can answer both:' Who receives from whom? ' and 'Who gives to whom?'. Accordingly, the structure of the relationships

may also be approached in two ways. We may examine how much is needed of the output of preceding stages, or of the primary inputs, for some purpose (either for final use or for a unit output of some industry); this is the input approach. But we may examine what will come out of something, either of primary inputs or of the unit output of some industry, in successive stages or in final use; this the output approach.

These approaches describe the transactions of products and values in two opposite directions. One of them asks: 'Where do they come from? ', the other: 'Where do they go? '.

For the purpose of the analysis of these linkages, I will use the following definitions.

First, the input coefficients matrix, $\underline{A}$, can be used to analyse backward linkages, (i.e., intermediate inputs as a share of total inputs, including value added). Mathematically we can represent the input coefficients matrix, in element form; as:

$$a_{ij} = \frac{z_{ij}}{x_j} \tag{1}$$

This is as earlier defined in the literature (see LEONTIEF, 1963 and 1966). But we can rewrite it in matrix form:

$$\underline{A} = \underline{Z}\ \ \underline{\hat{x}}^{-1} \tag{2}$$

Here, z_{ij} is intermediate demand, x_j is total demand, and $\underline{\hat{x}}$ is the diagonalised vector $\underline{x}$, as a matrix; $\underline{Z}$ is the matrix of intermediate transaction.

Second, several authors [BULMER-THOMAS, 1982; NUGENT, 1973; et. all] have suggested that an alternative point of view can be taken with the basic input-output model. This alternative relates sectoral gross production to the primary inputs (that is, to a unit of value entering the interindustry system at the beginning of the process). This approach is made operational by essentially transposing our vertical (column) view of the model to a horizontal (row) one. Instead of dividing each column of $\underline{Z}$ by the gross input of the sector associated with that column, divide each row of $\underline{Z}$ by the gross output of the sector associated with that row. We used $\underline{O}$ to denote the direct output coefficients matrix that results. The output coefficients matrix, $\underline{O}$, can be used to analyse forward linkages. (i.e., intermediate sales as a share of total sales including final demand). We can define the output coefficients matrix, $\underline{O}$, by:

$$O_{ij} = \frac{z_{ij}}{x_i} \tag{3}$$

Or in matrix notation:

$$\underline{O} = \underline{\hat{x}}^{-1}\underline{Z} \tag{4}$$

The input and output coefficients matrices for Malaysian Economy are available with author.

4. The Input Leontief Inverse and the Output Leontief Inverse

In this section, I should explain the meaning of the input Leontief inverse, $(I–A)^{-1}$, and the output Leontief inverse, $(I–O)^{-1}$. Briefly, the former is based on a matrix of technical input coefficients A. The latter uses technical output coefficients $\underline{O}$.

First, the input Leontief inverse, $(I–A)^{-1}$, elements may be interpreted [JONES, 1970; p.325] as follows:

(1) The elements of $(\underline{I}–\underline{A})^{-1}$ represent the increase in output of the ith industry to supply the inputs required for a unit of final demand in the jth industry.
(2) The ith row sum of $(\underline{I}–\underline{A})^{-1}$ is the increase in total output of the system required to utilize the increase in output from an initial unit of primary input into industry i.
(3) The column sums of $(\underline{I}–\underline{A})^{-1}$ represent the increase in total output of the system required to supply inputs for initial unit increase in final demand from each industry j.
Second, the output Leontief inverse, $(\underline{I}–\underline{O})^{-1}$ element may be interpreted as follows:

(1) The elements of $(\underline{I}–\underline{O})^{-1}$ represent the increase in output of the jth industry required to utilize the increase in output brought about by a unit of primary input into the ith industry.
(2) The ith row sum of $(\underline{I}–\underline{O})^{-1}$ is the increase in total output of the system required to utilize the increase in output from an initial unit of primary input into industry i.
(3) The column sum of $(\underline{I}–\underline{O})^{-1}$, like the row sum of $(\underline{I}–\underline{A})^{-1}$, has to do with the effect of a unit expansion of primary inputs into (or for final demand, from) all industries.
The input and output inverse matrices for Malaysia are available with author. For the purpose of this paper; I will define the elements of the input Leontief inverse matrix to be c_{ij} and the elements of the output Leontief inverse matrix to be v_{ij}.

5. The Data and Methodology

Basically, the present study uses secondary data based on the four input-output tables compiled for the Malaysian economy so far. These tables were produced by the Department of Statistics. For analytical and comparable purposes, the original input-output tables consisting of different number of sectors are aggregated into 39 sectors based on International Standard Industrial Classification (ISIC). These sectors are shown in Table 1.

5.1 Backward linkages

The backward linkage effect allows one to find the dependence of one industry on other industries in respect of the supply of inputs. It measures the extent to which one industry utilizes the outputs of industries. This implies that for a sector with a high backward linkage effect, by increasing the output of the specific industry a powerful stimulus is set into operation in other industries, to increase the outputs of those industries. The aim of this section is to measure the potential for other activities resulting from investment in any sector. One possible measure of direct backward linkage from the input coefficient matrix, $\underline{A}$, is the sum of the column elements [CHENERY, 1958; p.492]. i.e.

$$\underline{s}_j = \underline{i}'\underline{A} \tag{5}$$

$\underline{s}_j$ will measure the ratio of purchased inputs to the value of total production x_j, and $\underline{i}$ is the unit (summation) vector. I show the results of this measure for the Malaysian economy for 1983-2000 period in the Table 2.

Table 2

These show the direct backward linkages, derived from Equation (5). The value of direct backward linkages determines the values of input percentage of the value of production in these sectors. The remaining input value is attributable to factors used in other establishments.

The key points to note from Table 2 are the significant change in ranking of the most sectors except the Oils and Fats product. This sector is kept its ranking with high ranking for all tables under study. Agriculture, it will be noted, does not exhibit a significant long-term change in its ranking. Crude oil & Mining and Quarrying is mostly ranked last in all years. The ranking of this sector decreases markedly in the post 1983 period.

But this only measures direct backward linkages and takes no account of the indirect stimuli given to the economy if investment takes place. This measure has three deficiencies [JONES, 1970; p. 324]: double counting of causal linkage, neglect of indirect impacts, and failure to distinguish the domestic effect from those operating on foreign economies. The first problem is that in an input-output framework, sales of industry A to industry B are recorded as A's forward linkages and B's backward linkages, but only one of these can be effective in a causal sense. Causality is at the root of the HIRSCHMAN hypothesis using input-output interdependence as a proxy for linkages [JONES, 1970; p.325].

To measure both the direct and indirect effects, we need the LEONTIEF inverse matrix $(I-A)^{-1}$ (the input Inverse).We can get direct and indirect backward linkage for any sector j by the sum of the column elements of input inverse [YOTOPOULOS and NUGENT, 1976; p.335], as:

$$\underline{l}_j = \underline{i}'(\underline{I}-\underline{A})^{-1} \tag{6}$$

We see that $\underline{l}_j$ is the sum of the elements in column j of the LEONTIEF inverse. Now each element in column j measures the direct and indirect impact of the inverse of one unit in the final demand for industry j on each of the n industries. It must be noted that Equation 6 would be used also as a multiplier (see BEKHET, 2009). The results for the Malaysian economy are shown in Table 3.

Table 3

The comments made above about the significant changes in ranking shown in Table 2 are equally applicable to Table 3.

Typically, these elements are defined in terms of gross output values, and $\underline{l}_j$ is then the aggregate or economy-wide gross output generated by an increase of one unit in final demand in industry j. However, a normalization procedure is often carried out, by comparing the average stimulus created by sector j with the overall average [RASMUSSEN, 1957; pp.133-140]. The direct and indirect backward linkage index then becomes:

$$\underline{q}_j = \frac{1/n\ \underline{i}'(\underline{I}-\underline{A})^{-1}}{1/n^2\ \underline{i}'(\underline{I}-\underline{A})^{-1}\underline{i}} \tag{7}$$

The numerator denotes the average stimulus imparted to other sectors by a unit's worth of demand for sector j. The denominator denotes the average stimulus for the whole economy when all final demands increase by unity. Equation (7) has been applied to the input-output tables for the Malaysian economy. The results are shown in Table 4.

Table 4

As noted with Table 3, the comments on the changes in ranking applied to Tables 2 still apply when Table 4 is examined.

The difference between $\underline{l}_j$, as defined in Equation (6), and $\underline{q}_j$, as defined above, is the normalization in the latter by the number of sectors and by the double sum of columns and rows. Since the number of sectors and the double sum are obviously the same for any one country, $\underline{q}_j$ is simply perfectly correlated with itself after normalization by a constant [YOTOPOULOS and NUGENT, 1976; p.340]. It follows that $\underline{q}_j>1$ implies a jth sector where investment yields above average backward linkages, while the opposite is true for $\underline{q}_j<1$.

When $\underline{q}_j>1$, it means that an industry would need a comparatively large production increase to cope with one unit increase in the final demand for the product of industry j. The economic interpretation of $\underline{q}_j>1$ would be that the industry j would draw heavily on the rest of the industries, compared with other industries. On the other hand, $\underline{q}_j<1$ means that the industry j does not draw heavily on the rest of the industries. This measure was first devised by RASMUSSEN [1957], as the index of the power of dispersion (corresponding to the index of backward linkage). It is worth noting that this measure pre-dated ideas about the role of linkage in industrial development strategy, and was simply regarded as useful summary measure of the structural interdependence of an economy [McGILVRAY, 1977; p.50].

Reference to the ranking of $\underline{q}_j$ alone would not be sufficient to assist industrial planning, for a number of reasons. A high index could have been achieved, although only one or two sectors stand to gain from the backward linkages created by the investment. This can be taken into account by considering the dispersion of the stimuli according to the formula for the coefficient of variation:

$$J_j = \sqrt{\frac{(1/n-1)\sum_{i=1}^{n}\left(c_{ij}-1/n\sum_{i=1}^{n}c_{ij}\right)^2}{1/n\sum_{i=1}^{n}c_{ij}}} \tag{8}$$

This equation has been applied to the input-output tables for the Malaysian economy, for the period under study. These results are shown in Tables 5.

Table 5

The changes in ranking shown in Table 5 show some variation on those revealed in Tables 2-4. The ranking for Crude oil, Mining & Quarrying sector is moving up for all years, rather than at the last, whilst Oils & Fats product kept its rank at the first. There is significant change of the ranking for the most sectors for all tables. Agriculture, however, shows remarkable change over time.

A low J_j means that the investment in sector j would stimulate other sectors in an even manner, while a high J_j means that the benefits of the stimuli provided by backward linkage would be unevenly shared [BULMER-THOMAS, 1982; p,191]. On the other hand, in that case a relatively high value of J_j can be interpreted as showing to what extent a particular industry draws heavily on one or a few industries. Thus, a low value of J_j can be interpreted as that a particular industry draws evenly on other industries.

5.2 Forward linkages

The basic idea of forward linkage is to trace the output increase which occurs, or might occur, in using industries when there is a change in the sector supplying inputs. The forward linkage effect measures the dependence of one specific industry on other industries, in respect of the supply of its output as inputs to these industries. For an industry with a high forward linkage effect, it implies that by expanding the output of a specific industry a powerful stimulus is generated in other industries, by way of absorbing the output of the specific industry as inputs to other industries. The meaning of direct forward linkage may be derived from the output coefficient matrix $\underline{O}$. The direct forward linkage is the sum of the row elements of $\underline{O}$ matrix [YOTOPOULOS and NUGENT, 1973; p.161]:

$$\underline{s}_i = \underline{O}\,\underline{i} \tag{9}$$

Here, $\underline{s}_i$ denotes the ratio of intermediate demand to total demand, x_i, for a given product. These ratios for the Malaysian economy are shown in Table 6.

Table 6

The key points to note from Table 6 are the changes in ranking of the most sectors were fluctuating during the period under study. But there is some sector still keeping their ranking, these are Animal feeds product; Oil Palm Primary product; Electricity & Gas; Health; Education; Real estate & Ownership dwelling; Hotel & Restaurant; Building & Construction; and Furniture & Fixtures sectors. Agriculture, it will be noted, does have a decreasing significant long-term change in ranking. Once again, Animals Feeds product is ranked first in all years. While the ranking of the Health and education sectors are last in all tables.

However, this only measures direct forward linkage, and takes no account of the indirect stimuli given to the economy if the investment goes ahead. The measurement of direct and indirect forward linkage effects may be derived from the output inverse $(\underline{I}–\underline{O})^{-1}$, using the technical output coefficients matrix $\underline{O}$ (intermediate sales as a share of total sales including final demand), [CARTER and BRODY, 1970; pp.252-253]. We can get direct and indirect forward linkages from the sum of the row of the output inverse indicate forward linkage.

$$\underline{l}_i = (\underline{I}-\underline{O})^{-1}\,\underline{i} \tag{10}$$

The $(\underline{I}–\underline{O})^{-1}$ indicates the increase in the output of the sector i needed in order to cope with a unit increase in the final demand for the product of each industry [BOUCHER, 1976; p.314]. The results for the Malaysian economy are shown in Table 7.

Table 7

The comments made above about the significant changes in ranking shown in Table 6 are equally applicable to Table 7.

High forward linkages occur when a sector's output is, or could be, used by many other sectors as an input. By expanding capacity in such a sector, inducements are provided to using industries which now have an incentive to expand output, to take advantage of the increased availability of inputs. Given our interpretation of the ijth element of the output inverse, a suitable measure of forward linkages might therefore be the row sum of this inverse, which becomes:

$$\underline{q}_i = \frac{1/n(\underline{I}-\underline{O})^{-1}\underline{i}}{1/n^2\underline{i}'(\underline{I}-\underline{O})^{-1}\underline{i}} \tag{11}$$

This equation has been applied to the input-output tables for the Malaysian economy. These results are shown in the Tables 8.

Table 8

The comments on the changes in ranking also apply to Tables 6 and 7. The only change we can note is that the Oil Palm sector became second in ranking for 1983, 1987, 1991 and 2000 tables.

It is apparent that $\underline{q}_i > 1$ implies a sector with high forward linkage. It would mean that the industry i, in general, would have to increase its output more than the rest of the industries for a given increase in final demand on the system of industries, while the opposite is true where $\underline{q}_i < 1$. The index $\underline{q}_i$ (i = 1, 2, …, n) is thus termed the index of sensitivity of dispersion of the industries under consideration.

The numerator in Equation (11) refers to the ith row sum of the Leontief inverse, which in turn measures the total impact on sector i when the final demand for all sectors increases by unity. If this impact is large, it suggests that increased investment in sector i would induce output increases in all using sectors, as users take advantage of the increased availability of inputs. It might seem, therefore, that $\underline{q}_i$ is a good measure of forward linkages. This measure was first devised by RASMUSSEN, as the 'Index of Sensitivity of Dispersion' (forward linkage). But this measure, according to the ranking of $\underline{q}_i$ alone would not be sufficient to determine industrial planning. Another possibility also suggested by Rasmussen [RASMUSSEN, 1957; pp.138-139] it to look at the variance associated with each industry as:

$$J_i = \sqrt{\frac{(1/n-1)\sum_{j=1}^{n}\left(v_{ij}-1/n\sum_{j=1}^{n}v_{ij}\right)^2}{1/n\sum_{j=1}^{n}v_{ij}}} \tag{12}$$

I have applied this equation to the input-output tables for the Malaysian economy tables for 1983-2000 period. The results are shown in Tables 9.

Table 9

The changes in ranking shown in Table 9 show some variation on those revealed in Tables 6-8. Oil Palm Primary is fluctuating in the ranking for all years rather than second, whilst Oils & Fats product sector moves up to first in all years. The ranking of the Agriculture and Industry sectors move down in most years. If we compare the ranking of health, Education and other serves sectors with previous tables, we can see a significant change for these sectors.

A high value of J_i can be interpreted as showing to what extent a particular industry draws heavily on one or a few industries. A low variance shows that the system of industries draws relatively evenly on industry i and it might be concluded that in this case the row sum might be a reliable indicator of forward linkages. This is not the case, for the problem is not the dispersion of sales across industries, but the existence of sales that are a large share of a small industry. Thus a unity J_i, indicating sales to all industries, could still give distorted row sums if those sales represented a large share of inputs into small industries [JONES, 1970; P.326].

This measure of forward linkage is quite different from the backward linkage, because it measures the forward linkage as the increase in output of all using industries, rather than as the increase in output of the (one) supplying industry.

6. Results Analysis for the Malaysian Economy

To measure the linkage effects of the industrial sectors, the empirical results of the linkage indices are constructed in the framework of inter-industrial production relations. The data used for the construction of the indices are the input-output transaction coefficients matrices for the Malaysian economy.

In order to identify the high backward and forward linkage effects of sectors, the industrial sectors with $\underline{q}_j > 1$ and low J_j, and with $\underline{q}_i > 1$ and low J_i are selected and shown in Tables 10 to 13.

Tables 10-13

The input-output table for 1983 shows that there were sixteen sectors with high backward linkage effects. Of these sectors, one was Oils & Fats products and Foods production other Industries and the remaining fourteen were non-agricultural sectors. Next, there were nineteen sectors with high forward linkage effects, of which the highest ranking was the Animal Feeds product sector. The second ranking was the primary producing sectors such as Oil Palm primary products. The remaining seventeen sectors were the non-agricultural sectors. The two primary producing sectors and the sector of Non-Electrical Machinery and Equipment did not show a backward linkage effect.

Agriculture appeared to be very weakly linked to the national economy, giving rise to the suspicion that it was an enclave sector. It appears that the Agriculture sector, with its potential importance for import substituting and export promoting industries, had few links with the national economy.

However, the other three tables for 1987, 1991 and 2000 show the impact of a planning policy that paid greater attention to the structural sector change. From these three tables it will be noted that structural change becomes in most sectors linked to the national economy in the post 1983 era. But I think this change still far away from planners' targets.
As can also be seen from Tables 10-13, some sectors did change a great deal as a result of post 1983 changes in planning policy. i.e., Paper & Printing products, Basic Metal; other Transportation Equipment; Wholesale & Retail Trade; Real Estate & Ownership dwelling. In fact the ranking of the Crude Oil/Gas/Mining & Quarrying sector in the Malaysian economy during 1983-2000 has changed. The main differences are for commodity sectors, i.e. Manufacturing Industries, and these sectors seem to have a fluctuating position during the period under study.
Sectors with a high forward linkage effect and a high backward linkage effect could be regarded as key sectors of the Malaysian economy in the period under study. In addition, these sectors should be given high priority by planners in investment planning. These sectors for 1983, 1987, 1991 and 2000 tables are shown in Table 14.
Table 14
In tables 15-18, I have presented the matrices of Rank Correlation Coefficients among eight alternative linkage indices, including all the indices defined above. These results are based on the four input-output tables for the Malaysian economy, for which all eight indices, have been calculated from the original input-output tables. An examination of these matrices of Rank Correlation Coefficients shows that some of the indices (Coefficients of Variation) are quite unrelated, for all Indices. Also, the relations between $\underline{s}_j$ and $\underline{s}_i$; $\underline{l}_j$ and $\underline{l}_i$; $\underline{q}_j$ and $\underline{q}_i$ are uncorrelated. Note, in particular, that the backward and forward indices, q_j, $\underline{s}_j$, $\underline{l}_j$; and $\underline{q}_i$, $\underline{s}_i$, $\underline{l}_i$ are correlated, respectively with the indices which I have used above. Therefore, the main result of this analysis is that the integration degree between demand and supply side for the Malaysian economy still remain weak.
Tables 15-18
In fact, given the nature of the key sectors (and the emphasis on their spread effects), it may well be that the faster growth rates may be found in other sectors not identified as key sectors in Tables 10-13. BLUMENFELD [1955] noted the same problem whilst discussing the economic base model. Such sectors may be those with the greatest potential for achieving import substitution [HEWINGS, 1982]. It is expected that such sectors will be reflected as key sectors in the statistical data of coming years.

7. Policy Implications

The theoretical basis and aims of Malaysian planning policy since 1980 have been discussed in Section (2) and the details in [CHING, 2005]. To briefly summarise, the main aim of the planners was to develop the commodities sectors and integrate them with the rest of the economy. It would therefore be expected that the indirect linkages for these sectors would have a high ranking in terms of backward and forward linkages.
The results shown in Tables 10-13, and discussion in the previous sections (5 and 6), show how far this policy has been successfully achieved. The tables show that although some progress has been made, it falls far short of what the planners desired. The linkages between the commodities sectors and the rest of the economy still remain weak. There is still a high dependency on the primary sectors, such us Oil Palm, Rubber Primary products, and Crude Oil, Gas, Mining & Quarrying, and Wooden Sectors. Unfortunately, however, the primary sectors remain a classic example of an enclave export-oriented industry, superimposed on an entirely different type of economy, without any significant economic linkages between it and the rest of the economy. Agriculture, however, has been one area where planning policy has had some success in establishing linkages. But it had low backward linkages because its cost (input) structure is dominated by non-wage costs paid to factors of production. Also, it had low forward linkages since most of its output goes to private consumption. The main results of the policy were to transform Malaysia from an exporter to an importer of foodstuffs and other agricultural products [www.upe.gor].
In addition, the declining rate of growth in the Agriculture sector was the most profound factor in widening economic inequalities between urban and rural areas during the period of the plans. The failure in agriculture resulted in rural income remaining low, especially jungles areas.
Policy emphasised the domestic substitution of some of the growing volume of imported products, and in particular those of oil and rubber derived products. This implies that the planners should have undertaken the construction of a number of industrial projects linking commodities sectors to the consumer, either in the form of final consumable products, or in the form of intermediate goods utilised by other sectors. This, however, did not take place to any great extent.
The fact that not all potential linkages can be translated into actual linkages suggests the need for a modified form of linkages analysis, in which technological coefficients are adjusted for those growth stimuli which are not feasible for Malaysia; such non-feasibility will be determined by considerations of market-size, efficiency, comparative costs, natural resources, etc. The inducement which remains, as measured by the backward and forward linkages analysis, would then be a better guide to the selection of 'key' sectors.
Furthermore, sectors with high backward linkages have a high dependence on intermediate goods, which are typically capital-intensive. In the context of DCs, particularly Malaysia, we are therefore asking planners to give priority to

sectors which directly or indirectly are capital-intensive; although the argument over choice of techniques is complex; this is not a position to which most LDCs would want to be committed.

However, one needs to consider a more fundamental set of objections to linkage analysis based on economic theory. Industrialization is not usually considered as an objective in itself, but as proxy for the rise in real income which is supposed to accompany it. If, however, we consider real income growth per head as our objective, then each investment needs to be evaluated in terms of its direct and indirect income (not output) impact, which can be done by reference to the income multipliers introduced in BEKHET [2009] .

8. Conclusions

In this paper I have made an effort empirically to identify key sectors and structural changes in the Malaysian economy during the period 1983-2000, using the input-output tables for this period. In closing it may be appropriate to allude to a possible limitation of this study. The input-output relations used above assume that a given output requires inputs in fixed proportions, so that the production structure in various industries or groups of industries is fairly stable. This may be true of the modern sector industries in an underdeveloped economy, but it is well-known that the primitive sector in such economies is marked with variable coefficients with a high degree of substitution among inputs [BOUCHER, 1976; p.318]. A high degree of aggregation may fail to reveal the true pattern of linkages in such an economy [see BULMER-THOMAS, 1982, Ch.12].

To the extent that the modern sector dominates the primitive sector in such economies, the linkage value calculated above represents mostly the situation in the modern sector. In view of this, one is not quite sure if the values of linkages calculated above encompass both the primitive and the modern sector in these years, or the modern sector alone. Needless to say, it would be most desirable to utilize a large number of tables and to extend the time series. Yet the concept of linkages is a powerful tool in the economies of development.

These results although admittedly tentative, indicate that the linkage indices merit further attention and empirical research.

In this paper, I have explored only one of the input-output techniques to measure the success of development in Malaysia. The next paper uses multipliers technique to measure the success of development policy.

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Table 1. Aggregation of sectors.

No.	Sectors Names	Input-Output Tables	
		1991 & 2000	**1983 & 1987**
1	Agriculture products other	1, 4, 5	1
2	Rubber primary products	2	2
3	Oil palm primary products	3	3
4	Livestock breeding, etc	6	4
5	Forestry, logging product	7	5
6	Fishing, etc	8	6
7	Crude oil, Gas, Mining, Quarrying Product	9, 10, 11	7
8	Foods Production other	12-15, 17-21	8-9, 11-13
9	Oils and Fats product	16	10
10	Animal Feeds product	22	14
11	Beverages &Tobacco product	23-24, 25	15-16
12	Textile Products	26, 27, 28	17
13	Wearing Apparel	29, 30, 31	18
14	Wooden Products	32, 33	19
15	Furniture & Fixtures	34	20
16	Paper & Printing Products	35, 36	21
17	Industrial Chemicals	37	22
18	Paints, Lacquers & Other Chemical Product	38-41	23-24
19	Petroleum, Coal Product	42	25
20	Processed Rubber & Rubber Product	43-44	26-27
21	Plastic Products	45	28
22	China, Glass, Clay, cement & Other Non-met Mineral Products	46-49	29-31
23	Basic Metal & Other Metal Product	50-54	32-33
24	Non-Electricity and Electricity Machinery	55-59	34-35
25	Motor Vehicle Manufacturing	61	36
26	Other Transport Equipment	60, 62, 63	37
27	Other Manufacturing Products	64-65	38
28	Electricity & Gas	66	39
29	Water works and supply	67	40
30	Building & Construction	68	41
31	Wholesale &Retail Trade	69	42
32	Hotel & Restaurants	70	43
33	Transport	71	44
34	Communication	72	45
35	Banks, Financial & Insurance	73-75	46-47
36	Real estate & Ownership dwellings	76-77	48
37	Education	79-80	50, 56
38	Health	81-82	51, 57
39	Other Services	78, 83-94	49, 52-55, 58-60

Source: Malaysian Input-Output Tables for 1983, 1987, 1991 and 2000.

Table 2. Direct Backward Linkages, s_j.

Sector	1983		1987		1991		2000	
	Value	Rank	Value	Rank	Value	Rank	Value	Rank
1	0.112	34	0.146	32	0.182	33	0.188	31
2	0.087	36	0.061	39	0.081	37	0.060	39
3	0.143	32	0.164	31	0.078	38	0.188	32
4	0.599	4	0.570	6	0.666	4	0.698	2
5	0.170	31	0.093	36	0.088	36	0.146	35
6	0.087	37	0.121	33	0.213	31	0.396	14
7	0.133	33	0.079	38	0.106	35	0.079	38
8	0.614	3	0.630	4	0.587	6	0.566	4
9	0.886	1	0.830	1	0.843	1	0.858	1
10	0.385	15	0.391	12	0.321	19	0.280	26
11	0.320	18	0.382	15	0.388	12	0.378	19
12	0.495	10	0.383	14	0.306	21	0.375	20
13	0.302	21	0.265	26	0.244	29	0.391	16
14	0.550	5	0.628	5	0.732	3	0.654	3
15	0.543	7	0.519	8	0.518	7	0.472	8
16	0.288	22	0.317	17	0.288	25	0.396	15
17	0.318	19	0.470	11	0.331	15	0.499	6
18	0.405	14	0.371	16	0.326	17	0.378	18
19	0.503	8	0.650	3	0.814	2	0.505	5
20	0.686	2	0.739	2	0.633	5	0.486	7
21	0.323	17	0.265	25	0.382	13	0.286	24
22	0.411	13	0.388	13	0.417	10	0.463	9
23	0.496	9	0.487	10	0.425	9	0.345	22
24	0.242	27	0.180	30	0.265	26	0.206	28
25	0.214	28	0.288	20	0.297	24	0.374	21
26	0.182	30	0.293	18	0.307	20	0.397	13
27	0.302	20	0.241	28	0.300	22	0.333	23
28	0.422	12	0.195	29	0.298	23	0.270	27
29	0.380	16	0.289	19	0.326	16	0.421	12
30	0.477	11	0.506	9	0.407	11	0.440	11
31	0.258	25	0.267	23	0.252	27	0.158	34
32	0.546	6	0.532	7	0.492	8	0.444	10
33	0.265	23	0.268	22	0.347	14	0.390	17
34	0.111	35	0.111	34	0.204	32	0.206	29
35	0.207	29	0.280	21	0.248	28	0.182	33
36	0.086	38	0.087	37	0.078	39	0.145	36
37	0.085	39	0.107	35	0.141	34	0.136	37
38	0.250	26	0.246	27	0.236	30	0.192	30
39	0.261	24	0.266	24	0.322	18	0.285	25

Sector Names: as shown in Table 1.

Source: Malaysian Input-Output Tables for 1983, 1987, 1991, and 2000.

$$\underline{s}_j = \underline{i}' \underline{A}$$

Table 3. Indirect Backward Linkages, l_j.

Sector	1983		1987		1991		2000	
	Value	Rank	Value	Rank		Value	Rank	Value
1	1.161	35	1.221	32	1.268	33	1.287	29
2	1.130	39	1.092	39	1.123	37	1.106	39
3	1.209	32	1.247	31	1.115	39	1.305	28
4	1.969	3	1.972	3	2.134	2	2.183	2
5	1.258	31	1.136	37	1.134	36	1.208	35
6	1.135	37	1.189	33	1.330	31	1.623	11
7	1.197	33	1.115	38	1.155	35	1.111	38
8	1.987	2	2.000	2	1.962	5	1.922	3
9	2.824	1	2.691	1	2.691	1	2.966	1
10	1.691	10	1.719	10	1.581	13	1.461	24
11	1.479	18	1.566	15	1.597	12	1.575	20
12	1.813	7	1.578	13	1.445	22	1.580	19
13	1.482	17	1.386	24	1.347	28	1.591	18
14	1.776	8	1.809	7	1.963	4	1.866	5
15	1.904	4	1.835	5	1.833	6	1.718	7
16	1.418	22	1.452	18	1.415	25	1.591	17
17	1.467	20	1.629	12	1.476	20	1.896	4
18	1.625	14	1.570	14	1.498	17	1.594	16
19	1.627	13	1.766	9	2.012	3	1.616	13
20	1.854	5	1.885	4	1.828	7	1.703	8
21	1.478	19	1.381	26	1.561	14	1.437	25
22	1.612	15	1.551	16	1.625	11	1.689	9
23	1.686	11	1.697	11	1.640	9	1.498	22
24	1.352	27	1.253	30	1.375	26	1.280	30
25	1.307	28	1.419	19	1.439	23	1.554	21
26	1.267	30	1.484	17	1.452	21	1.613	14
27	1.450	21	1.344	28	1.430	24	1.475	23
28	1.656	12	1.295	29	1.511	16	1.389	27
29	1.603	16	1.418	20	1.492	18	1.618	12
30	1.737	9	1.788	8	1.634	10	1.652	10
31	1.374	24	1.385	25	1.360	27	1.232	34
32	1.852	6	1.809	6	1.766	8	1.749	6
33	1.390	23	1.404	21	1.535	15	1.605	15
34	1.162	34	1.152	35	1.282	32	1.275	32
35	1.290	29	1.386	23	1.345	29	1.241	33
36	1.145	36	1.148	36	1.122	38	1.194	37
37	1.131	38	1.159	34	1.209	34	1.204	36
38	1.374	25	1.355	27	1.344	30	1.275	31
39	1.374	25	1.395	22	1.477	19	1.412	26

Sector Names: as shown in Table 1.

Source: Malaysian Input-Output Tables for 1983, 1987, 1991, and 2000.

$$\underline{l}_j = \underline{i}'(\underline{I} - \underline{A})^{-1}$$

Table 4. Index of Power Dispersion of Backward Linkages, q_j.

Sector	1983		1987		1991		2000	
	Value	Rank	Value	Rank	Value	Rank	Value	Rank
1	0.764	35	0.811	32	0.831	33	0.832	29
2	0.743	39	0.726	39	0.736	37	0.715	39
3	0.796	32	0.828	31	0.731	39	0.844	28
4	1.296	3	1.311	3	1.398	2	1.412	2
5	0.828	31	0.755	37	0.743	36	0.781	35
6	0.747	37	0.790	33	0.872	31	1.050	11
7	0.788	33	0.741	38	0.757	35	0.718	38
8	1.307	2	1.329	2	1.286	5	1.243	3
9	1.858	1	1.788	1	1.764	1	1.919	1
10	1.113	10	1.143	10	1.036	13	0.945	24
11	0.973	18	1.041	15	1.047	12	1.019	20
12	1.193	7	1.049	13	0.947	22	1.022	19
13	0.975	17	0.921	24	0.883	28	1.029	18
14	1.168	8	1.202	7	1.287	4	1.207	5
15	1.253	4	1.220	5	1.201	6	1.111	7
16	0.933	22	0.965	18	0.928	25	1.029	17
17	0.965	20	1.083	12	0.967	20	1.227	4
18	1.069	14	1.044	14	0.982	17	1.031	16
19	1.071	13	1.174	9	1.319	3	1.045	13
20	1.220	5	1.253	4	1.198	7	1.101	8
21	0.973	19	0.918	26	1.023	14	0.929	25
22	1.060	15	1.031	16	1.065	11	1.093	9
23	1.110	11	1.128	11	1.075	9	0.969	22
24	0.889	27	0.833	30	0.901	26	0.828	30
25	0.860	28	0.943	19	0.943	23	1.005	21
26	0.834	30	0.986	17	0.951	21	1.044	14
27	0.954	21	0.893	28	0.937	24	0.954	23
28	1.090	12	0.861	29	0.990	16	0.899	27
29	1.055	16	0.942	20	0.978	18	1.047	12
30	1.143	9	1.189	8	1.071	10	1.069	10
31	0.904	25	0.920	25	0.891	27	0.797	34
32	1.219	6	1.202	6	1.158	8	1.131	6
33	0.915	24	0.933	21	1.006	15	1.038	15
34	0.765	34	0.765	35	0.840	32	0.825	32
35	0.849	29	0.921	23	0.881	29	0.803	33
36	0.753	36	0.763	36	0.736	38	0.772	37
37	0.744	38	0.770	34	0.793	34	0.779	36
38	0.904	26	0.901	27	0.881	30	0.825	31
39	0.917	23	0.927	22	0.968	19	0.913	26

Sector Names: as shown in Table 1.

Source: Malaysian Input-Output Tables for 1983, 1987, 1991, and 2000.

$$\mathbf{q_j} = \frac{1/n \ \underline{i}'(\underline{I}-\underline{A})^{-1}}{1/n^2 \ \underline{i}'(\underline{I}-\underline{A})^{-1}\underline{i}}$$

Table 5. Coefficient of Variation of Backward Linkages, J_j.

Sector	1983		1987		1991		2000	
	Value	Rank	Value	Rank	Value	Rank	Value	Rank
1	0.940	8	0.920	12	0.902	17	0.950	8
2	0.945	5	0.956	3	0.942	11	0.950	9
3	0.907	16	0.894	16	0.946	8	0.876	26
4	0.798	34	0.813	33	0.874	25	0.924	13
5	0.902	17	0.939	5	0.938	12	0.934	12
6	0.944	6	0.920	13	0.887	22	0.875	27
7	0.929	13	0.951	4	0.945	9	0.963	6
8	0.794	35	0.780	35	0.780	37	0.824	34
9	1.127	1	1.126	1	1.140	1	1.178	1
10	0.788	36	0.772	36	0.804	35	0.889	23
11	0.829	30	0.841	31	0.824	33	0.848	32
12	0.979	3	1.008	2	0.957	4	0.879	25
13	0.840	28	0.891	19	0.897	19	0.861	29
14	0.853	24	0.868	27	0.850	29	0.839	33
15	0.754	38	0.762	37	0.758	38	0.817	37
16	0.918	14	0.922	11	0.925	13	0.951	7
17	0.949	4	0.879	23	0.887	23	0.850	31
18	0.820	31	0.807	34	0.835	31	0.819	36
19	0.886	21	0.893	17	0.898	18	0.893	20
20	0.847	26	0.872	25	0.846	30	0.921	14
21	0.836	29	0.864	28	0.821	34	0.868	28
22	0.859	23	0.885	21	0.893	20	0.908	15
23	0.892	19	0.937	6	0.957	5	0.969	5
24	0.901	18	0.918	14	0.945	10	0.944	10
25	0.983	2	0.927	9	0.947	7	0.978	4
26	0.937	10	0.828	32	0.989	2	0.991	2
27	0.846	27	0.875	24	0.858	28	0.858	30
28	0.809	32	0.884	22	0.827	32	0.890	22
29	0.799	33	0.858	30	0.919	14	0.819	35
30	0.763	37	0.754	38	0.788	36	0.786	38
31	0.866	22	0.870	26	0.878	24	0.907	17
32	0.742	39	0.751	39	0.754	39	0.770	39
33	0.912	15	0.912	15	0.889	21	0.893	21
34	0.941	7	0.933	8	0.965	3	0.905	18
35	0.931	12	0.893	18	0.914	15	0.937	11
36	0.935	11	0.936	7	0.948	6	0.984	3
37	0.937	9	0.926	10	0.906	16	0.907	16
38	0.850	25	0.863	29	0.865	26	0.882	24
39	0.890	20	0.890	20	0.862	27	0.899	19

Sector Names: as shown in Table 1.

Source: Malaysian Input-Output Tables for 1983, 1987, 1991, and 2000.

$$\mathbf{J_j} = \sqrt{\frac{(1/n-1)\sum_{i=1}^{n}\left(c_{ij} - 1/n\sum_{i=1}^{n} c_{ij}\right)^2}{1/n\sum_{i=1}^{j=1} c_{ij}}}$$

Table 6. Direct Forward Linkages, s_i.

Sector	1983		1987		1991		2000	
	Value	Rank	Value	Rank	Value	Rank	Value	Rank
1	0.452	18	0.422	15	0.373	20	0.363	20
2	0.527	11	0.770	3	0.789	3	0.750	4
3	0.677	6	0.627	7	0.678	6	0.723	6
4	0.500	13	0.474	12	0.452	15	0.427	16
5	0.336	23	0.377	19	0.451	16	0.607	8
6	0.329	24	0.303	25	0.383	18	0.452	13
7	0.372	21	0.396	17	0.361	21	0.347	22
8	0.219	28	0.210	30	0.239	28	0.372	18
9	0.481	17	0.489	11	0.489	13	0.577	10
10	0.913	1	0.920	1	0.935	1	0.949	1
11	0.076	37	0.106	36	0.143	34	0.172	32
12	0.378	20	0.335	24	0.258	26	0.313	24
13	0.163	33	0.108	35	0.078	37	0.147	33
14	0.482	16	0.375	20	0.262	25	0.268	28
15	0.128	35	0.125	32	0.111	35	0.119	34
16	0.747	4	0.684	5	0.742	3	0.571	11
17	0.545	9	0.384	18	0.322	22	0.439	15
18	0.510	12	0.347	22	0.374	19	0.411	17
19	0.570	8	0.346	23	0.551	10	0.447	14
20	0.149	34	0.122	33	0.168	33	0.274	27
21	0.487	15	0.533	10	0.457	14	0.207	31
22	0.826	3	0.833	2	0.812	2	0.725	5
23	0.528	10	0.630	6	0.570	9	0.600	9
24	0.167	32	0.094	37	0.176	32	0.096	36
25	0.180	31	0.211	29	0.233	29	0.299	25
26	0.187	30	0.437	13	0.550	11	0.482	12
27	0.240	27	0.137	31	0.215	30	0.217	30
28	0.681	5	0.684	4	0.737	5	0.768	3
29	0.864	2	0.569	8	0.646	7	0.807	2
30	0.093	36	0.117	34	0.101	36	0.080	37
31	0.380	19	0.427	14	0.495	12	0.722	7
32	0.365	22	0.371	21	0.294	24	0.323	23
33	0.489	14	0.399	16	0.421	17	0.351	21
34	0.581	7	0.548	9	0.582	8	0.368	19
35	0.278	25	0.224	27	0.214	31	0.107	35
36	0.267	26	0.283	26	0.301	23	0.283	26
37	0.007	39	0.011	39	0.026	39	0.009	39
38	0.025	38	0.036	38	0.034	38	0.016	38
39	0.210	29	0.218	28	0.256	27	0.230	29

Sector Names: as shown in Table 1.

Source: Malaysian Input-Output Tables for 1983, 1987, 1991, and 2000.

$\mathbf{s_i} = \underline{O}\ \underline{i}$

Table 7. Indirect Forward Linkages, l_i.

Sector	1983		1987		1991		2000	
	Value	Rank	Value	Rank	Value	Rank	Value	Rank
1	1.664	17	1.591	18	1.537	21	1.688	17
2	1.637	18	1.900	8	1.967	7	2.052	6
3	2.300	2	2.216	2	2.315	2	2.602	2
4	1.699	15	1.662	13	1.671	14	1.689	16
5	1.545	22	1.560	19	1.604	18	1.852	10
6	1.514	24	1.453	25	1.541	20	1.709	15
7	1.678	16	1.642	14	1.646	17	1.596	19
8	1.324	28	1.314	29	1.349	26	1.569	20
9	1.921	9	1.943	6	1.945	9	2.254	3
10	2.563	1	2.752	1	2.779	1	2.668	1
11	1.109	37	1.140	36	1.203	34	1.244	32
12	1.555	21	1.461	24	1.328	28	1.406	26
13	1.217	33	1.141	35	1.099	37	1.182	33
14	1.610	19	1.479	23	1.329	27	1.338	29
15	1.161	35	1.153	34	1.148	36	1.140	35
16	2.158	4	2.069	4	2.177	3	1.910	9
17	1.980	8	1.666	12	1.522	22	1.732	14
18	1.753	12	1.518	22	1.557	19	1.620	18
19	1.991	7	1.546	20	1.954	8	1.794	12
20	1.205	34	1.169	32	1.227	33	1.404	27
21	1.718	14	1.758	11	1.661	16	1.290	30
22	2.051	6	2.103	3	2.096	5	1.980	7
23	1.723	13	1.918	7	1.835	12	1.822	11
24	1.220	32	1.128	37	1.232	32	1.120	37
25	1.244	31	1.301	30	1.326	29	1.440	24
26	1.275	30	1.641	15	1.905	10	1.764	13
27	1.327	27	1.189	31	1.297	31	1.289	31
28	2.077	5	2.058	5	2.166	4	2.193	5
29	2.263	3	1.840	9	2.021	6	2.239	4
30	1.134	36	1.169	33	1.152	35	1.126	36
31	1.577	20	1.624	16	1.714	13	1.976	8
32	1.530	23	1.535	21	1.442	24	1.513	23
33	1.763	11	1.617	17	1.662	15	1.525	21
34	1.858	10	1.796	10	1.887	11	1.520	22
35	1.427	25	1.340	27	1.326	30	1.150	34
36	1.384	26	1.406	26	1.463	23	1.418	25
37	1.010	39	1.018	39	1.043	39	1.016	39
38	1.031	38	1.043	38	1.047	38	1.023	38
39	1.297	29	1.317	28	1.388	25	1.346	28

Sector Names: as shown in Table 1.

Source: Malaysian Input-Output Tables for 1983, 1987, 1991, and 2000.

$\mathbf{l_i} = (\underline{I}\text{-}\underline{O})^{-1}\ \underline{i}$

Table 8. Index of Sensitivity of Dispersion of Forward Linkages, q_i.

Sector	1983		1987		1991		2000	
	Value	Rank	Value	Rank	Value	Rank	Value	Rank
1	1.038	17	1.014	18	0.958	21	1.042	17
2	1.022	18	1.211	8	1.226	7	1.266	6
3	1.435	2	1.412	2	1.443	2	1.606	2
4	1.060	15	1.060	13	1.042	14	1.042	16
5	0.964	22	0.994	19	1.000	18	1.143	10
6	0.945	24	0.926	25	0.961	20	1.055	15
7	1.047	16	1.047	14	1.026	17	0.985	19
8	0.826	28	0.838	29	0.841	26	0.968	20
9	1.199	9	1.239	6	1.212	9	1.391	3
10	1.599	1	1.755	1	1.732	1	1.646	1
11	0.692	37	0.727	36	0.750	34	0.767	32
12	0.971	21	0.932	24	0.828	28	0.867	26
13	0.759	33	0.728	35	0.685	37	0.729	33
14	1.005	19	0.943	23	0.828	27	0.826	29
15	0.724	35	0.735	34	0.716	36	0.704	35
16	1.346	4	1.319	4	1.357	3	1.179	9
17	1.236	8	1.062	12	0.949	22	1.069	14
18	1.094	12	0.968	22	0.970	19	1.000	18
19	1.242	7	0.985	20	1.218	8	1.107	12
20	0.752	34	0.745	32	0.765	33	0.866	27
21	1.072	14	1.120	11	1.036	16	0.796	30
22	1.280	6	1.340	3	1.306	5	1.222	7
23	1.075	13	1.223	7	1.144	12	1.124	11
24	0.762	32	0.719	37	0.768	32	0.691	37
25	0.776	31	0.829	30	0.827	29	0.889	24
26	0.796	30	1.046	15	1.187	10	1.088	13
27	0.828	27	0.758	31	0.809	31	0.796	31
28	1.296	5	1.312	5	1.350	4	1.353	5
29	1.412	3	1.173	9	1.260	6	1.382	4
30	0.708	36	0.745	33	0.718	35	0.695	36
31	0.984	20	1.035	16	1.068	13	1.220	8
32	0.955	23	0.979	21	0.899	24	0.933	23
33	1.100	11	1.031	17	1.036	15	0.941	21
34	1.159	10	1.145	10	1.177	11	0.938	22
35	0.891	25	0.854	27	0.826	30	0.710	34
36	0.864	26	0.897	26	0.912	23	0.875	25
37	0.630	39	0.649	39	0.650	39	0.627	39
38	0.643	38	0.665	38	0.653	38	0.631	38
39	0.810	29	0.840	28	0.865	25	0.831	28

Sector Names: as shown in Table 1.

Source: Malaysian Input-Output Tables for 1983, 1987, 1991, and 2000.

$$\mathbf{q_i} = \frac{1/n(\underline{I}-\underline{\underline{O}})^{-1}\underline{i}}{1/n^2\underline{i}'(\underline{I}-\underline{\underline{O}})^{-1}\underline{i}}$$

Table 9. Coefficient Variation of Forward Linkages, J_i.

Sector	1983		1987		1991		2000	
	Value	Rank	Value	Rank	Value	Rank	Value	Rank
1	0.813	29	0.834	29	0.837	28	0.852	30
2	0.883	23	0.918	16	0.918	19	0.916	20
3	1.023	3	0.975	7	1.009	2	1.019	2
4	0.884	22	0.901	20	0.963	11	1.006	6
5	0.853	24	0.854	23	0.864	25	0.809	35
6	0.827	26	0.841	27	0.846	27	0.867	28
7	0.800	32	0.796	33	0.805	32	0.822	33
8	0.962	7	0.949	11	0.938	15	0.924	17
9	1.317	1	1.286	1	1.303	1	1.322	1
10	0.886	18	0.929	13	0.971	10	0.976	11
11	0.961	8	0.989	4	0.954	12	0.959	13
12	1.060	2	1.051	2	1.002	3	0.940	16
13	0.923	15	0.981	6	0.994	5	0.998	8
14	0.905	16	0.916	18	0.952	13	0.914	23
15	0.932	13	0.948	12	0.952	14	1.004	7
16	0.754	35	0.777	35	0.751	38	0.866	29
17	0.816	28	0.847	25	0.868	24	0.883	27
18	0.791	33	0.820	30	0.817	31	0.811	34
19	0.740	37	0.839	28	0.761	37	0.800	36
20	0.949	10	0.972	8	0.981	8	1.011	4
21	0.777	34	0.768	36	0.795	34	0.916	21
22	0.896	17	0.881	22	0.891	21	0.909	24
23	0.884	21	0.900	21	0.919	18	0.898	26
24	0.949	9	0.967	10	0.998	4	1.010	5
25	1.009	4	0.968	9	0.987	6	1.017	3
26	0.935	12	0.792	34	0.872	23	0.954	14
27	0.885	19	0.928	15	0.896	20	0.917	19
28	0.690	38	0.695	39	0.687	39	0.703	38
29	0.672	39	0.748	38	0.788	35	0.698	39
30	0.945	11	0.929	14	0.937	16	0.948	15
31	0.807	31	0.801	32	0.786	36	0.756	37
32	0.819	27	0.818	31	0.835	29	0.829	31
33	0.811	30	0.849	24	0.854	26	0.915	22
34	0.750	36	0.752	37	0.798	33	0.827	32
35	0.884	20	0.907	19	0.920	17	0.974	12
36	0.848	25	0.842	26	0.830	30	0.901	25
37	0.995	5	0.991	3	0.979	9	0.992	9
38	0.988	6	0.989	5	0.985	7	0.990	10
39	0.925	14	0.917	17	0.889	22	0.922	18

Sector Names: as shown in Table 1.

Source: Malaysian Input-Output Tables for 1983, 1987, 1991, and 2000.

$$\mathbf{J_i} = \sqrt{\frac{(1/n-1)\sum_{j=1}^{n}\left(v_{ij} - 1/n\sum_{j=1}^{n} v_{ij}\right)^2}{1/n\sum_{j=1}^{j=1} v_{ij}}}$$

Table 10. Backward and Forward Linkages for 1983.

Industrial Sectors	Linkages effect	Coefficient of Variation
Backward Linkage	$q_j > 1$	J_j
1. Oils and Fats product	1.858	1.127
2. Foods Production other	1.307	0.794
3. Livestock breeding, etc	1.296	0.798
4. Furniture & Fixtures	1.253	0.754
5. Processed Rubber & Rubber Product	1.220	0.847
6. Hotel & Restaurants	1.219	0.742
7. Textile Products	1.193	0.979
8. Wooden Products	1.168	0.853
9. Building & Construction	1.143	0.763
10. Animal Feeds product	1.113	0.788
11. Basic Metal & Other Metal Product	1.110	0.892
12. Electricity & Gas	1.090	0.809
13. Petroleum, Coal Product	1.071	0.886
14. Paints, Lacquers & Other Chemical Product	1.069	0.820
15. China, Glass, Clay, cement & Other Non-met Mineral Products	1.060	0.859
16. Water works and supply	1.055	0.799
Forward Linkage	$q_i > 1$	J_i
1. Animal Feeds product	1.599	0.886
2. Oil palm primary products	1.435	1.023
3. Water works and supply	1.412	0.672
4. Paper & Printing Products	1.346	0.754
5. Electricity & Gas	1.296	0.690
6. China, Glass, Clay, cement & Other Non-met Mineral Products	1.280	0.896
7. Petroleum, Coal Product	1.242	0.740
8. Industrial Chemicals	1.236	0.816
9 Oils and Fats product	1.199	1.317
10. Communication	1.159	0.750
11. Transport	1.100	0.811
12. Paints, Lacquers & Other Chemical Product	1.094	0.791
13. Basic Metal & Other Metal Product	1.075	0.884
14. Plastic Products	1.072	0.777
15. Livestock breeding, etc	1.060	0.884
16. Crude oil, Gas, Mining, Quarrying Product	1.047	0.800
17. Agriculture products other	1.038	0.813
18. Rubber primary products	1.022	0.883
19. Wooden Products	1.005	0.905

Source: Tables,4-5 and 8-9.

Table 11. Backward and Forward Linkages for 1987.

Industrial Sectors	Linkages effect	Coefficient of Variation
Backward Linkage	$q_j > 1$	J_j
1. Oils and Fats product	1.788	1.126
2. Foods Production other	1.329	0.780
3. Livestock breeding, etc	1.311	0.813
4. Processed Rubber & Rubber Product	1.253	0.872
5. Furniture & Fixtures	1.220	0.762
6. Hotel & Restaurants	1.202	0.751
7. Wooden Products	1.202	0.868
8. Building & Construction	1.189	0.754
9. Petroleum, Coal Product	1.174	0.893
10. Animal Feeds product	1.143	0.772
11. Basic Metal & Other Metal Product	1.128	0.937
12. Industrial Chemicals	1.083	0.879
13. Textile Products	1.049	1.008
14. Paints, Lacquers & Other Chemical Product	1.044	0.807
15. Beverages &Tobacco product	1.041	0.841
16. China, Glass, Clay, cement & Other Non-met Mineral Products	1.031	0.885
Forward Linkage	$q_i > 1$	J_i
1. Animal Feeds product	1.755	0.929
2. Oil palm primary products	1.412	0.975
3. China, Glass, Clay, cement & Other Non-met Mineral Products	1.340	0.881
4. Paper & Printing Products	1.319	0.777
5. Electricity & Gas	1.312	0.695
6. Oils and Fats product	1.239	1.286
7. Basic Metal & Other Metal Product	1.223	0.900
8. Rubber primary products	1.211	0.918
9. Water works and supply	1.173	0.748
10. Communication	1.145	0.752
11. Plastic Products	1.120	0.768
12. Industrial Chemicals	1.062	0.847
13. Livestock breeding, etc	1.060	0.901
14. Crude oil, Gas, Mining, Quarrying Product	1.047	0.796
15. Other Transport Equipment	1.046	0.792
16. Wholesale &Retail Trade	1.035	0.801
17. Transport	1.031	0.849
18. Agriculture products other	1.014	0.834

Source: Tables,4-5 and 8-9.

Table 12. Backward and Forward Linkages for 1991.

Industrial Sectors	Linkages effect	Coefficient of Variation
Backward Linkage	$q_j > 1$	J_j
1. Oils and Fats product	1.764	1.140
2. Livestock breeding, etc	1.398	0.874
3. Petroleum, Coal Product	1.319	0.898
4. Wooden Products	1.287	0.850
5. Foods Production other	1.286	0.780
6. Furniture & Fixtures	1.201	0.758
7. Processed Rubber & Rubber Product	1.198	0.846
8. Hotel & Restaurants	1.158	0.754
9. Basic Metal & Other Metal Product	1.075	0.957
10. Building & Construction	1.071	0.788
11. China, Glass, Clay, cement & Other Non-met Mineral Products	1.065	0.893
12. Beverages &Tobacco product	1.047	0.824
13. Animal Feeds product	1.036	0.804
14. Plastic Products	1.023	0.821
15. Transport	1.006	0.889
Forward Linkage	$q_i > 1$	J_i
1. Animal Feeds product	1.732	0.971
2. Oil palm primary products	1.443	1.009
3. Paper & Printing Products	1.357	0.751
4. Electricity & Gas	1.350	0.684
5. China, Glass, Clay, cement & Other Non-met Mineral Products	1.306	0.891
6. Water works and supply	1.260	0.788
7. Rubber primary products	1.226	0.918
8. Petroleum, Coal Product	1.218	0.761
9. Oils and Fats product	1.212	1.303
10. Other Transport Equipment	1.187	0.872
11. Communication	1.177	0.798
12. Basic Metal & Other Metal Product	1.144	0.919
13. Wholesale &Retail Trade	1.068	0.786
14. Livestock breeding, etc	1.042	0.963
15. Transport	1.036	0.854
16. Plastic Products	1.036	0.795
17. Crude oil, Gas, Mining, Quarrying Product	1.026	0.805
18. Forestry, logging product	1.000	0.864

Source: Tables,4-5 and 8-9.

Table 13. Backward and Forward Linkages for 2000.

Industrial Sectors	Linkages effect	Coefficient of Variation
Backward Linkage	$q_j > 1$	J_j
1. Oils and Fats product	1.919	1.178
2. Livestock breeding, etc	1.412	0.924
3. Foods Production other	1.243	0.824
4. Industrial Chemicals	1.227	0.850
5. Wooden Products	1.207	0.839
6. Hotel & Restaurants	1.131	0.770
7. Furniture & Fixtures	1.111	0.817
8. Processed Rubber & Rubber Product	1.101	0.921
9. China, Glass, Clay, cement & Other Non-met Mineral Products	1.093	0.908
10. Building & Construction	1.069	0.786
11. Fishing, etc	1.050	0.875
12. Water works and supply	1.047	0.819
13. Petroleum, Coal Product	1.045	0.893
14. Other Transport Equipment	1.044	0.991
15. Transport	1.038	0.893
16. Paints, Lacquers & Other Chemical Product	1.031	0.819
17. Paper & Printing Products	1.029	0.951
18. Wearing Apparel	1.029	0.861
19. Textile Products	1.022	0.879
20. Beverages &Tobacco product	1.019	0.848
21. Motor Vehicle Manufacturing	1.005	0.978
Forward Linkage	$q_i > 1$	J_i
1. Animal Feeds product	1.646	0.976
2. Oil palm primary products	1.606	1.019
3. Oils and Fats product	1.391	1.322
4. Water works and supply	1.382	0.698
5. Electricity & Gas	1.353	0.703
6. Rubber primary products	1.266	0.916
7. China, Glass, Clay, cement & Other Non-met Mineral Products	1.222	0.909
8. Wholesale &Retail Trade	1.220	0.756
9. Paper & Printing Products	1.179	0.866
10. Forestry, logging product	1.143	0.809
11. Basic Metal & Other Metal Product	1.124	0.898
12. Petroleum, Coal Product	1.107	0.800
13. Other Transport Equipment	1.088	0.954
14. Industrial Chemicals	1.069	0.883
15. Fishing, etc	1.055	0.867
16. Livestock breeding, etc	1.042	1.006
17. Agriculture products other	1.042	0.852
18. Paints, Lacquers & Other Chemical Product	1.000	0.811

Source: Tables 4-5 and 8-9.

Table 14. key Sectors of the Malaysian Economy.

1983	**1987**
1. Oils & Fats product	1. Oils & Fats product
2. Livestock breeding	2. Livestock breeding
3. Wooden Products	3. Animals Feeds product
4. Animals Feeds product	4. Basic Metal
5. Basic Metal	5. Industrial Chemical
6. Electricity & Gas	6. China, Glass, Cement & Non met Mineral Products
7. Petroleum & Coal product	
8. Paints, Lacquers & Other Chemical Product	
9. China, Glass, Cement & Non met Mineral Products	
10. Water works & Supply	
1991	**2000**
1. Oils & Fats product	1. Oils & Fats product
2. Livestock breeding	2. Livestock breeding
3. Petroleum & Coal product	3. Industrial Chemical
4. China, Glass, Cement & Non met Mineral Products	4. China, Glass, Cement & Non met Mineral Products
5. Animals Feeds product	5. Fishing
6. Plastic Products	6. Water works & Supply
7. Transport	7. Petroleum & Coal product
	8. Other transport Equipment
	9. Paints, Lacquers & Other Chemical Product
	10. Paper & Printing Products

Source: Tables 10-13.

Table 15. Matrix of Rank Correlation Coefficients among Linkage Indices for 1983.

	s_j	s_i	l_j	l_i	q_j	q_i	J_j	J_i
s_j	1							
s_i	0.0969	1						
l_j	0.966	0.112783	1					
li	0.0969	0.972967	0.131087	1				
q_j	0.966	0.111953	0.999955	0.130376	1			
q_i	0.0969	0.973002	0.131188	0.999999	0.13048	1		
J_j	-0.2456	-0.00138	-0.12291	0.058015	-0.12302	0.058389	1	
J_i	0.3331	-0.42158	0.442739	-0.35276	0.443106	-0.3525	0.409292	1

Source: Tables 2-9.

Table 16. Matrix of Rank Correlation Coefficients among Linkage Indices for 1987.

	s_j	s_i	l_j	l_i	q_j	q_i	J_j	J_i
s_j	1							
s_i	-0.06568	1						
l_j	0.953048	-0.00385	1					
li	-0.01924	0.964659	0.065218	1				
q_j	0.953151	-0.00394	0.999999	0.065068	1			
q_i	-0.01898	0.964576	0.06564	0.999999	0.065491	1		
J_j	-0.19741	0.121838	-0.10686	0.114157	-0.1074	0.114129	1	
J_i	0.413807	-0.33955	0.519847	-0.24867	0.519726	-0.24834	0.348589	1

Source: Tables 2-9.

Table 17. Matrix of Rank Correlation Coefficients among Linkage Indices for 1991.

	s_j	s_i	l_j	l_i	q_j	q_i	J_j	J_i
s_j	1							
s	-0.06199	1						
l_j	0.961125	-0.01707	1					
li	-0.02785	0.969754	0.032206	1				
q_j	0.961157	-0.01725	0.999999	0.032071	1			
q_i	-0.02795	0.969766	0.032094	0.999999	0.031959	1		
J_j	-0.13615	0.237234	-0.04183	0.246496	-0.0418	0.246382	1	
J_i	0.305599	-0.31214	0.428074	-0.232	0.428136	-0.23221	0.343549	1

Source: Tables 2-9.

Table 18. Matrix of Rank Correlation Coefficients among Linkage Indices for 2000.

	s_j	s_i	l_j	l_i	q_j	q_i	J_j	J_i
s_j	1							
s_i	0.013846	1						
l_j	0.951798	0.070554	1					
li	0.061896	0.960242	0.15257	1				
q_j	0.951765	0.070745	0.999999	0.152714	1			
q_i	0.061775	0.960227	0.152441	0.999999	0.152585	1		
J_j	0.007555	0.197217	0.190413	0.256371	0.190385	0.25636	1	
J_i	0.380476	-0.30659	0.511522	-0.15187	0.511404	-0.15207	0.472582	1

Source: Tables 2-9.