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INTERINDUSTRIAL LINKAGES AND THE AGENDA FOR SECTORAL PROMOTION – A REVISIT

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Abstract

Economic sectors which are closely related to the rest of the economy (key sectors) through backward and forward interindustry linkages may be exploited to induce greater rates of economic growth. Following the Hirschmanian Unbalanced Growth Hypothesis, an economy may grow at a greater rate, if investment resources are concentrated to the key sectors, than if the same resources are distributed differently. Key sectors may be identified by the better than average, interindustry linkage index, measured using the input-output analytic approach. The measured interindustry linkage index of the Malaysian economy shows that key sectors are generally concentrated in sectors which undertake manufacturing activities. However, certain sectors in agriculture and services industries also exhibit strong interindustry linkages. As a strategy to hasten the economic growth of the Malaysian economy, these identified key sectors may be considered for exploitation by concentrating investment resources to them.

Keywords: INTERINDUSTRIAL LINKAGES, SECTORAL PROMOTION

1. Introduction

Planning for economic development is a standard practice of the Malaysian government. Strategic and short term planning charts the path of the economic development of Malaysia. The practice predates independence from British rule in 1957. Each short- term plan runs for five years. The first development plan, called the First Five-Year Plan, which was launched in 1956, ran until 1960 (Mohd Noor 1997). The following plan is called the Second Five-Year Plan, and ran from 1961 until 1965. Due to the formation of Malaysia, with the territorial addition of Sabah and Sarawak in North Borneo, the subsequent plans are each called Malaysia Plans. The current running plan is the Seventh Malaysia Plan, which is to run from 1996 until the year 2000.

Long term plan is effected through the Outline Perspective Plans (OPPs). From pre-independence until the current times, there are only two such plans namely OPP1 and OPP2. OPP1, which is the first attempt at long-range planning, ran from 1971 until 1990. This is followed by the Second Outline Perspective Plan (OPP2) which is to run until the end of this millenium.

These plans chart the path of economic development in Malaysia. Specifically they identify economic sectors for promotion in order to satisfy the national objective of a united and just society. Early plans have stressed largely on the development of sectors undertaking agricultural production activities and the emplacement of needed infrastructure. Government intervention in the market place was minimal (Spinanger 1980). The little market intervention encouraged the establishment of social and industrial infrastructure, thereby creating an environment, which allowed the economy to flourish. The other aim is to establish a wider economic base, thereby reducing the economic vulnerability of depending principally on rubber and tin. Broadening of the economic base by introducing and expanding manufacturing activities was seen to be a solution to the wider social problems of widespread unemployment and socio-economic imbalance between races (Hadi 1994).

In the Fifth and Sixth Malaysia Plan document, there has been mention of the importance of interindustry linkages as a mechanism for generating greater rates of economic growth. Mention of such concept has also been made in the First Industrial Master Plan (IMP), another development plan, focussing mainly on industrial promotion. However, the chief criteria in the identification of sectors for promotion are 1) Resource Based Industries and 2) Non-Resource Based Industries. The former select sectors are readily linked backwards to the domestic sources of inputs. Hence, industries that are based on rubber, palm oil, food processing, wood, petroleum, non-ferrous and non-metallic mineral products were given the focus. In sectors, undertaking manufacturing activities, which are non-domestic backward linking, are also considered strong engines of growth. These sectors are electronics and electrical equipment, transport equipment, machinery and engineering products, ferrous metal products, textiles and apparel. The subsequent plan, the Second IMP, 1996-2000, published in 1996 identified sector clusters for promotion. The identified clusters are based on interdependencies of economic sectors in the acquisition and sale of inputs outputs respectively (Malaysia 1996).

In this paper, the identification of key economic sectors of the Malaysian economy employing the concept of interindustry linkages is considered. Interindustry linkage analysis can be a potent tool in selecting economic sectors for promotion because the exploitation of strong linkage industries is predicted to generate greater rates of economic growth, given a fixed amount of investment resources (Hirschman 1958).

2. Theoretical Foundation

Production activities are governed by the adopted technology whereby various inputs are combined together in the production process in order to produce the required output/s. Inputs are generally produced by other economic entities. The relationship between the producer of output and the supplier of inputs *is backward interindustry linkage*.

Assuming an intermediate-producing sector, the output it produces is not for the direct consumption by the final consumers or *final demand*. The output is required by other producers as inputs in their production processes dictated by an adopted production technology. The relationship between the producer of the output and its user is a *forward interindustry linkage* concept.

The above two inter-industrial relationships may be exploited in order to induce greater rates of economic growth because interindustry linkages may be viewed as a transmission mechanism of the effect of an upward change in final demand on the level of activity of the producing sectors of an economy. Assuming a fixed input ratio, demand is induced to increase through the imposition of policy instruments. Consequently, an economic sector will be induced to increase production. In response to the backward interindustry linkage stimuli, an economic sector would increase its demand for all types of inputs that the sector uses in its production process. In turn, the input suppliers are also induced to increase their output in order to satisfy the increased demand by their downstream markets. This set of input suppliers would also need greater amounts of inputs from their input suppliers and so on. The relationship between the producer and the second and subsequent set of input suppliers is an *indirect backward interindustry linkage* relationship.

Similarly, apart from satisfying the increase in final demand, the sector also produces output for the benefits of its downstream markets. Due to the increase in its output and the fixed input ratio assumption, its immediate downstream market is induced to increase production. In turn, the subsequent sets of sectors in the downstream market are also induced to increase production. The relationship between the sector and the subsequent sets of sectors is *an indirect forward interindustry linkage* relationship.

The increased output by all related sectors is over and above the amount transferred to the final demand sector. Consequently, the induced increase in final demand through government intervention has resulted in the increase in the total output of the economy. The increase in the total output is in fact an economic growth. The size of the response of the economy to the increases in final demand can be indicated by interindustry linkage index measure.

Suppose that the sector in question has a normalized interindustry linkage index of 0.5[1], and due to government promotion, raises demand by 10 units. The sector increases its production by five units, over and above the 10 units being transferred to satisfy the increase in final demand. Total output has increased by 15 units. However if the backward interindustry linkage index is 1.5, a similar increase in the final demand would induce the sector to increase from itself and all backward linkage sources, a quantity of output of 25 units. Ten units of the output are transferred to the final demand sector.

A similar interpretation may be made from the forward interindustry linkage perspective. If the measure of forward interindustry linkage index for the sector is 0.5, a 10-unit increase in the final demand will cause the total increase in output of the economy by 15 units. Ten units are transferred to the final demand sector while the five units to the other producing sectors. However, if the forward interindustry-linkage index is 1.5, a similar increase in the quantity demanded will cause a total increase in the output of the system by 25 units. Ten units are transferred to the final demand sector, while 15 units to the rest of the economy.

As illustrated, strong interindustry linked sectors are capable of inducing greater rates of economic growth than weak interindustry linkage sectors. This can be exploited by economic development planners aimed at inducing greater rates of economic growth of an economy. This is the basis of the Unbalanced Growth Hypothesis proposed by Hirschman (1958). In the

[1] Normalized interindustry linkage index has a mean of unity. Strong interindustry linkage sector has an index greater than unity. A weak interindustry linkage sector has an index number less than unity.

Unbalanced Growth Strategy for economic development, a given amount of investment resources can bring about a greater rate of economic growth if they are concentrated in strong linkage sectors. Strong linkage sectors may be defined as those sectors, which have better than average interindustry linkage indices. These sectors, if promoted, are potent engines of growth for the economy. These sectors are called *key sectors* because their expansion, through the interindustry linkage mechanism, brings about the increased activities in related sectors and subsequently effect greater rates of economic growth.

Current evidence on the relationship between strong interindustry linkage sectors and greater rates of economic growth can be gleaned from past experiences in some countries. Using only the backward interindustry linkage index, it was found that countries, which comply with the Unbalanced Growth Strategy, do not grow at a faster rate than those countries, which did not (Yotopoulos and Nugent 1973). However, this can be due to the over concentration of resources causing serious bottleneck problems, thereby choking the growth process. It was found that countries that had allocated investment resources proportionally to interindustry linkage strengths had grown much faster than countries, which did not. This implies the important role of interindustry linkages in inducing economic growth.

In Costa Rica, promotion of strong interindustry linkage sectors by way of an import substitution strategy has resulted in the accelerated growth of the key sectors (Bulmer-Thomas 1978). However, when promotion stopped, *realized* interindustry linkages of these sectors declined without affecting the interindustry linkage strengths of the other sectors. Realized interindustry linkage, indicate the extent by which the sector had internalized production. The measure utilizes input-output data sourced from the domestic origin. Interindustry linkage strength in this class of interindustry relations may change in value with increased internalization.

On the other hand, *potential* interindustry linkage indicates interindustry relations, which includes both domestic and imported inputs. This is a more stable measure of interindustry linkage strength. The difference between the two linkage perspectives indicates opportunities for internalization. As internalization occurs, the realized interindustry linkage index will approach the potential interindustry linkage value. In the case of Costa Rica, the stoppage of promotion has somewhat reduced the realized interindustry linkage indices. However, the economy has grown to a higher level of output than before the promotion.

Sustenance of realized interindustry linkage indices in Costa Rica have not occurred because domestic input producing industries have insufficient time to establish. When protection was lifted, these industries lost the market they intend to serve. In addition, the promoted industries were generally *finishing touches* industries, which are characterized by strong backward and weak forward interindustry linkages. The associated up-stream markets are capital intensive industries. These industries are slow to be established and expand due to the extensive capital and technological requirements (Reidel 1976). In order to serve the immediate market, intermediate products were imported, facilitated by the free trade policy. Once the free trade policy was terminated, the internalization process was reduced. The process however, lifted the economy to a higher level of output.

3. Methodology

Identification of key sectors, which are characterized by above average backward and/or forward interindustry linkage strengths, requires the measurement of their relative strengths. The natural approach to the measurement is the Input-Output Analysis.

Consider the generalized input-output table shown in Table 1. The input-output table is divided into four quadrants. The first quadrant represented by the n-producing sectors by n-input sectors matrix $\mathbf{Q}=[q_{ij}]$[2], where I, j=1,2,3,….,n. Along the rows of **Q**, each element is interpreted as the transaction of the quantities of products from sector i to the receiving sector j. Along the columns, each element represents the value of inputs purchased from sector j by sector i. The notation $\mathbf{F}=[f_I]$ stands for an n by 1 column vector of final demand. The 1 by n row vector **Y** represents the flow of primary inputs to the production sector. The matrix $\mathbf{X}=[x_j]$ in the Totals column represents an n by 1 column vector of total output.

Table 1

A Simplified Input-Output Table of an Open Static Economic System

	n-Producing Sectors	Final Demand Sector	Total Output
n-Producing Sectors	$\mathbf{Q}=[q_{ij}]$	$\mathbf{F}=[f_j]$	$X=[x_j]$
All Primary Inputs	$\mathbf{Y}=[y_j]$	**D**	$\sum_{j=1}^{n}\mathbf{y}_j+\mathbf{D}$
Total Input	$\mathbf{X}'=\left[x_j'\right]$	$\Sigma f_j+\mathbf{D}$	-

Note: Expressions in [ ] indicate elements of a matrix.

To the above notation, the symbol $\hat{\mathbf{X}}$ is added. This represents a diagonal matrix whose diagonal elements are the inscribed vector of total inputs **X**. Consequently, the technical coefficient matrix **A** is given by $\mathbf{Q}\hat{\mathbf{X}}^{-1}$. Due to the structure of the input-output matrix, direct backward and forward interindustry linkage indices may be obtained from the sums of the columns and rows of **A** respectively (Chenery and Watanabe 1958). The elements of $\mathbf{A}=[a_{ij}]$ indicates the amount of input from sector i required to produce a unit of output in sector j. In this approach, the problem has been considered from the input perspective. The important question is the source of the products received by the economic sector under consideration (Augustinovics 1970). The matrix **A** "relates gross production to the final product, to the unit of product leaving the interindustry

[2] Symbols in [ ] represents elements of a matrix.

system at the end of the process". In this perspective, the employment of the **A**-Matrix to account for backward interindustry linkages is well suited.

However, the concept of forward interindustry linkages concerns the distribution of output; answering the question of "who gives to whom?". In this sense, the technical coefficient matrix is not able to account for the forward interindustry linkages. Forward interindustry linkages may be accounted for by adopting the output coefficient matrix, represented by $\bar{\mathbf{A}}$, computed as $\hat{\mathbf{x}}^{-1}\mathbf{Q}$. An element of the matrix $\bar{\mathbf{A}}$, $\bar{a}_{ij}$ is the amount production in sector j sourced from a unit of primary input from sector i. It relates production to the unit of primary input entering the production system.

The employment of matrices **A** and $\bar{\mathbf{A}}$ to account for the relative strengths of backward and forward interindustry linkages may only account for the direct effects. First introduced by Chenery and Watanabe (1958), hereafter denoted by CW_b and CW_f respectively, may be computed from:

$$CW_b = \frac{\sum_{i=1}^{n} q_{ij}}{x'_j} \qquad (1)$$

$$CW_f = \frac{\sum_{j=1}^{n} q_{ij}}{x_j} \qquad (2)$$

The above measures of backward and forward interindustry linkages only account for direct effects. Therefore, they are neither exhaustive nor representative since indirect interindustry linkage effects have not been included. The respective Leontief inverse matrices (**Z** and $\bar{\mathbf{Z}}$) may account for all backward and forward interindustry linkages. Hence, the source data for the measurement of direct and indirect backward and forward interindustry linkages are $\mathbf{Z} = (\mathbf{I} - \mathbf{A})^{-1}$ and $\bar{\mathbf{Z}} = (\mathbf{I} - \mathbf{A})^{-1}$.

The elements of **Z** and $\bar{\mathbf{Z}}$ are z_{ij} and $\bar{z}_{ij}$. An element $z_{ij,}$ is the total increase in output sourced from the whole system of industries in order to cope with a unit increase in the final demand. The primary concern is the *source* of the inputs. The element $\bar{z}_{ij}$ indicates the total value of output emanating from sector j for every unit of primary input in sector i. In other words, the measure relates total production to the unit of primary input which enters the interindustry system.

Direct and indirect backward and forward interindustry linkages, first introduced by Rasmussen (1956) can be accounted for from the column and row summations of **Z** and $\bar{\mathbf{Z}}$. This is referred to as the R-Indices (R), where the subscript b and f denote backward and forward interindustry linkages respectively. These measures may be computed from:

$$R_b = \frac{\frac{1}{n}(z_j)}{\frac{1}{n^2}\sum_{i=1}^{n} z_j} \qquad (3)$$

$$R_f = \frac{\frac{1}{n}(\bar{z}_i)}{\frac{1}{n^2}\sum_{i=1}^{n} \bar{z}_i} \qquad (4)$$

In both instances, the problem of sectorial importance has not been properly addressed. All sectors of an economy are considered as of equal importance. The resulting interindustry indices can be rather misleading especially when compared between sectors. In order to compensate for this problem, weights can be incorporated in the measure. The most obvious weighting scheme is the total output vector.

However, consider a purely intermediate sector which produces products only for use by other sectors in further processing activities. All input sources are obtained from other intermediate industries and all outputs are transferred to other intermediate producers. Total output of the sector is comprised of all intermediate products. Interindustry linkage is strong because the sector uses all intermediate inputs to produce intermediate products. The sector imparts greater impact on the total output of the economy than other sectors. This is the strongest reason why interindustry linkage analysis adopting the hypothetical with and without the concerned sector proposed by Shultz (1977) and with and without interindustry trade advocated by Cella (1984) is not adopted in this study. Both methods breaks down when pure intermediate sector is encountered whereby final demand is zero.

Other sectors, in addition to supplying the input requirements of the intermediate industries, produce some for the final demand sector. The output satisfying the final demand is no longer active. It does not contribute to further production activities. The sector is less important from the interindustry linkage perspective. In this sense, interindustry linkage indices itself is most appropriately be used as weights.

Let us consider the unweighted backward CW-Index for an n-sector economy, where $\mathbf{r}'$ ($\mathbf{r}'>0$) is considered as a vector of row weights. Let the symbol **i** be a unit column vector of dimension n (also called the summation vector) whose element $i_1 = 1$ (for all i). The weighted direct backward interindustry linkage index ($\mathbf{m}_1$) is computed from:

$$\mathbf{m}_1' = \frac{n\mathbf{r}'\mathbf{A}}{(\mathbf{r}'\mathbf{A}\mathbf{i})} \qquad (5)^3$$

[3] **r** is initially taken as the total output vector. The weight is normalized so that its total equals unity.

In the first iteration, we obtain a first approximation of the direct backward interindustry linkages measure. The result may again be used as weights (in place of **r′**) in the next iteration where the new measure $\mathbf{m_2}$, is obtained from:

$$\mathbf{m}_2' = \frac{n\mathbf{m}_1'\mathbf{A}}{(\mathbf{r}'\mathbf{A}\mathbf{i})} \qquad (6)$$

When equation (5) is substituted in equation (6), we obtain:

$$\mathbf{m}_2{}' = n\frac{n\mathbf{r}'\mathbf{A}^2/(\mathbf{r}'\mathbf{A}\mathbf{i})}{n\mathbf{r}'\mathbf{A}^2\mathbf{i}/(\mathbf{r}'\mathbf{A}\mathbf{i})} = \frac{n\mathbf{r}'\mathbf{A}^2}{(\mathbf{r}'\mathbf{A}^2\mathbf{i})} \qquad (7)$$

The above iterations may be continued until iteration number k when the expression becomes:

$$\mathbf{m}_k' = \frac{n\mathbf{m}_{k-1}'}{\mathbf{m}_{k-1}'\mathbf{A}\mathbf{i}} = \frac{n\mathbf{r}'\mathbf{A}^k}{\mathbf{r}'\mathbf{A}^k\mathbf{i}} \qquad (8)$$

Employing the unique mathematical properties of the matrix **A** may alleviate the need for tedious iterations. **A** is assumed to be primitive and acyclic square matrix. In practical terms, this require that the matrix has at least one diagonal element $a_{ij}>0$. This assumption precludes input and output flows between only distinct groups of industries in an economy (Takayama 1974). Although seen as being rather restrictive, this assumption may be satisfied in most economies, including the Malaysian input-output table. To satisfy the assumption, only one diagonal entry in the table needs to be positive. In the Malaysian table, we find many.

The A-Matrix may be linearly transformed such that:

$$\mathbf{AE} = \lambda\mathbf{E} \qquad (9)$$

The symbol λ represents a constant term called the eigenvalue (or characteristic root), and **E**, a non-zero vector (or eigenvector). By the Perron Theorem, as generalized by Frobenus concludes that a primitive matrix always has one dominant, positive real eigenvalue (λ*), and that all other eigenvalues do not exceed this value (Pease 1965). This is *the Perron root*. Associated with this root is the corresponding eigenvector (*Perron vector*), which can be normalized and have coordinates that are real and positive. When there occur changes in any element of **A**, then there is a corresponding change in the value of λ* (Takayama 1974).

Associated with λ*, we have the left- and right-hand eigenvectors, denoted by $\mathbf{E}_L'$ and $\mathbf{E}_R$ respectively. Considering the backward interindustry linkages, we have:

$$\mathbf{E}_L'\mathbf{A} = \lambda^*\mathbf{E}_L'(\lambda^* > 0), \text{ and} \qquad (10)$$

Solving the above relationship for $\mathbf{E}_L'$, we obtain the unweighted backward interindustry linkages. However, $\mathbf{E}_L'$ can be negative and therefore is not definable in terms of interindustry linkage strengths. They are positive only in the normalized form.

Element-wise, the matrix $\mathbf{A}^{k}/\lambda^{*k}$ converges to $\mathbf{E_E E_L}/(\mathbf{iE_R})(\mathbf{E_L'i})$. The numerator in equation (8) converges to $n\mathbf{E_L}'(\mathbf{iE_R})/(\mathbf{i'E_R})(\mathbf{E_L}'\mathbf{i})$. The denominator of equation (8) converges to $n(\mathbf{E_L}'\mathbf{i})(\mathbf{r'E_R})/(\mathbf{i'E_R})(\mathbf{E_L'i})$. Therefore,

$$\lim_{k\to\infty} \mathbf{m}_k' = \frac{n\mathbf{E}_L'}{\mathbf{E}_L'\mathbf{i}} \qquad (11)$$

The backward CW-Index, when iteratively weighted by interindustry linkage index, converges to equation (11). This is the backward interindustry linkage index, first developed by Diezenbacher (1992). In this paper, it is referred to as the D-Index.

Similarly, consider the inverted Leontief matrix ($\mathbf{Z} = (\mathbf{I} - \mathbf{A})^{-1}$), by which the total direct and indirect backward interindustry linkages may be measured. The weighted R-Index can be specified as:

$$\tilde{\mathbf{m}}_1' = \frac{n\mathbf{r'Z}}{\mathbf{r'Zi}} \qquad (12)$$

As above, when the iterations are carried out, the expression converges to $\lim_{k\to\infty} \mathbf{m}_k' = \frac{n\mathbf{E}_L'}{\mathbf{E}_L'\mathbf{i}}$. Hence, the backward D-Index may be computed from either the CW- or R-Indices.

Forward interindustry linkages may also be computed the same way but the output coefficient matrix is used instead. Hence, the initial forward interindustry linkage (CW-Index) may be indicated by $\bar{\mathbf{A}}\mathbf{i}$. The elements of $\bar{\mathbf{A}}\mathbf{i}$ indicate the share of output, which remains within the production process. In the next round of production, the part of the output that remains in the production process is $\bar{\mathbf{A}}^{\mathbf{2}}\mathbf{i}$. In the k-th round of production, the proportion of the original output, which remains in the production process, is $\bar{\mathbf{A}}^{\mathbf{k}}\mathbf{i}$. Hence, this measure accounts for both direct and indirect backward interindustry linkages. When the expression is normalized so that the elements sums to unity, we obtain:

$$\frac{n\bar{\mathbf{A}}^{k}\mathbf{i}}{\mathbf{i'}\bar{\mathbf{A}}\mathbf{i}}, \text{ and}$$

$$\lim_{k\to\infty} \frac{n\bar{\mathbf{A}}^{k}\mathbf{i}}{(\mathbf{i'}\bar{\mathbf{A}}^{k}\mathbf{i})} = \frac{n\mathbf{E}_R}{(\mathbf{i'E}_R)} \qquad (13)$$

Equation (13) is the forward D-Index. It is also noted that if the derivation originates from the inverted Leontief matrix as was demonstrated with backward linkages, convergence would be to the same expression as in (13).

4. Data Adjustment

The data compiled in national accounts are nominal, by nature, which means that they are expressed in the currency of a specific country at a specific time (Reich 2009). The country has a certain territorial extension, and time is measured over a certain interval, usually a year, but both extensions are considered small enough for the model of a "point economy" to hold. A unit of currency represents the same economic value regardless of the place and time of expenditure within the boundaries of the country.

This is the precondition on which the construction of economic accounts with resulting balances depends, in order to be meaningful. Such accounting figures can be added and subtracted, because they are expressed in the same homogeneous unit of economic value. When the territorial boundary is transgressed this measurement breaks down, obviously, because the currency is not current outside. A similar limit holds for the interval in time, which is less obvious because change is not discrete here, but it needs not much reflection to realize that a euro of year 2008 is not of the same value as a euro of 1975, and the two cannot be added directly be employed within one and the same account. A technique must be applied to make values of the two years comparable. It is called technique of deflation and proceeds as follows:

Consider an elementary nominal aggregate of transactions at the lowest level of aggregation vt for year t (e.g. pharmaceuticals at the two digit level). Price statistics furnishes a corresponding price index pt describing the movement of the currency's purchasing power in respect to this aggregate. A volume index qt is defined from these data by means of

$$q_t = \frac{1}{P_t}\frac{V_t}{V_0} \qquad (1)$$

Where V_0 is the nominal value of the aggregate at some reference year 0, chosen arbitrarily. The volume index of a higher aggregate Q_t at time t is then defined as:

5. Past Results

The 1983 input-output data of the Malaysian economy is used in the analysis. Potential and realized D-Indices for each sector is computed. Economic sectors that score above average total D-Indices are considered to be key sectors.

Absolute values of the D-Indices are in the form of eigenvectors, which may be negative. Hence absolute values of D-Indices have no economic meaning. Instead, the gaps between potential and realized absolute values of the R-Indices were computed to indicate relative opportunities for internalization of economic sectors.

In the Malaysian economy, it is found that there are 17 potential and 12 realized key sectors, identified using the total D-Index criterion as shown in Table 2. From this criterion, economic sectors which score total D-Index of 2.0 or better are considered as key sectors of the

Table 2
Potential and Realized Key Sectors Determined Using Total D-Index Criterion, Malaysia 1983

	Industry	Total Linkage		Diff.
		Potential	Realized	
1	Other Agriculture	X	**3.10**	0.95
2	Oil Palm Estates	X	**26.62**	0.35
3	Mining	**9.30**	*3.75*	1.60
4	Oils and Fats	X	**28.13**	0.50
5	Textiles	2.01	X	1.70
6	Paper and Printing	**3.30**	2.33	2.38
7	Industrial Chemicals	**8.40**	**7.11**	4.30
8	Paints, etc.	4.70	X	2.36
9	Petroleum Products	**4.97**	**3.87**	2.21
10	Rubber Products	**3.46**	X	0.99
11	Basic Metals	**5.56**	X	3.05
12	Non-Electric Machinery	3.06	X	3.39
13	Electric Machinery	*2.62*	X	2.66
14	Motor Vehicles	**34.33**	X	3.77
15	Other Transport Equipment	3.34	X	5.17
16	Electricity, Gas, and Steam	**2.30**	**2.75**	5.17
17	Trade	3.54	4.33	0.57
18	Transport and Storage	3.16	**4.33**	1.24
19	Insurance	2.03	3.07	1.10
20	Business Services	**2.90**	2.16	1.61

Notes:
1. Indices are normalized to a mean of 2.0.
2. Diff.: Gap between non-normalized potential and realized R-Index,
3. Bold: Strong backward and forward D-Index; Italics: Strong Backward D-Index; Normal print: Strong forward D-Index; X denotes non-key sector.

Malaysian economy. As mentioned earlier, average backward or forward D-Indices is unity. Consequently, the average of the total backward and forward D-Indices is 2.0.

In this analysis, of the 17 potential key sectors, 11 sectors are found in sectors undertaking manufacturing activities and five sectors in the broad services sector. In the primary production category, only Mining is identified as a potential key sector. However, realized key sectors are not manufacturing dominant. Two realized key sectors, namely general agriculture and Oil Palm Estates are in the broad agricultural sector. All potential key sectors in the broad services category are also considered as realized key sectors by the D-Index criterion.

As seen from the table, interindustry linkage indices for the economic sectors Mining, Industrial Chemicals, Motor Vehicles, Oil Palm Estates and Oils and Fats scored extremely high index

values. These indices should not be interpreted literally although they can be considered as strong linkage sectors. Their extremely high D-Index values are due to the *enclaved effect* in their inter-sectorial trade. In the computation of the D-Index, when sectors tend to trade within a cluster of sectors, the resulting index value is magnified. If the input and output flows for the Oil Palm estates and Oils and Fats sectors are scrutinized from the Malaysian input-output table, it is found that all output from the former are transferred to the latter for processing. This is because, in Malaysia, the Oil Palm Estate sector is defined as the oil palm farming activities up to the production and transport of the oil palm fresh fruit bunches (FFB) to the palm oil mill for oil extraction. The oil extraction process and other activities in the downstream markets are classified as the Oils and Fats sector. However, in view of this finding, these two sectors should have been classified as a single sector. For the purpose of this study, it is referred to as the *Oils and Fats cluster*. Promotion must be carried out together due to their heavy input and output interdependencies. Independent promotion policies may create serious bottleneck problems, which may result in an impeded growth of the sector, which finally will slow down the growth of the total economy.

The same situation is true with the other sectors, which exhibit magnified D-Indices. These sectors include Mining, Textiles, Industrial Chemicals, and Motor Vehicles sectors. When the Malaysian input-output tables were scrutinized, it is found that the Mining sector trades mainly with Petroleum Products, Electricity, Gas and Steam, and Transport and Storage. In Malaysia, the Mining sector is dominated by the production of petroleum, which is the main input for the rest of the cluster members. In Industrial Chemicals and Motor Vehicles sectors, trade is mainly within the sector itself. Hence, these sectors stand alone as their own cluster. Hence, promotion activities can be independent, unlike in the Oils and Fats and the Mining clusters.

Planning of the Malaysian economic development have not adopted the interindustry linkage strategy. In the past, the economy was predominantly agricultural. The economy depended mainly on the primary production of rubber and tin. In the 1960s, the economic thinking of the leaders were to widen the economic base to reduce the economic vulnerability from placing heavy dependence on rubber and tin. Within the agricultural sector, this was implemented through the promotion of a new crop, oil palm. Coincidentally, this crop including its downstream activities is strongly linked to the rest of the economy. Therefore, this sector imparts strong growth stimulus to the rest of the economy.

Rubber production was modernized through the injection of new technology, sourced from local research and development activities. Although primary output of rubber does not posses a strong link to the rest of the economy, its downstream sector, Rubber products is. However, this sector could not be extensively exploited due to existing structural problems (Hadi 1994). Rubber production was dominated by foreign owned companies, which were generally made up of multinational corporations (MNCs). These entities locate their rubber processing plants foreign countries. Hence, these corporations have strong incentives to export raw rubber (rather than finished rubber products) to these offshore locations. Domestic rubber processing companies, which are relatively small producers, are engaged only in the manufacture of rubber articles, footwear, etc., imparting relatively little impact on the interindustry linkage exploitation. More ambitious plans to produce and export finished rubber products such as tubes and tires, were hampered by static world demand and over-capacity, which moved against profits.

Unlike rubber, the Oils and Fats cluster, which comprised of Oil Palm Estates and Oils and Fats sectors are both strong linkage sectors. Expansion of the sectors is propelled by extremely encouraging returns facilitated by strong world demand for oils and fats and its products. Cultivated area expansion is accomplished through the development of forest areas and the replacement of rubber and other crop areas. The sustained high profit obtained from oil palm cultivation is seen as a solution to the prevailing poverty problem in the rural areas. The poor and the landless from the rural areas are resettled in government sponsored land development schemes implemented through the Federal Land Development Authority (FELDA) and the Federal Land Consolidation and Rehabilitation Authority (FELCRA), both semi-government organizations. Promotion is also accorded through the financing of oil palm and palm oil research through the Palm Oil Research Institute of Malaysia (PORIM).

Since after independence from British colonization in 1957, the economic thinking of the political leaders to diversify the Malaysian economy was to concentrate on expanding sectors which undertakes manufacturing activities. This broad sector is considered to be a potent engine of growth. Until the year 1970, this sector was promoted through the import substitution strategy. The main idea of sectorial promotion was to complement the agricultural sector and the construction of infrastructure. Hence the promoted activities were fertilizers, cement and iron. In relation to the identified key sectors from Table 2, excluding Cement, these sectors are in fact key sectors. Fertilizer is part of the Industrial Chemicals sector while iron is included in the Basic Metals sector.

Related to the economic diversification strategy, the sector Textiles was promoted. Its promotion was mainly due to the strong affinity of the sector, to absorb labour. Unlike present day Malaysia, employment opportunities during the 1970s were scarce. It is among the first sectors that was targeted for export promotion during the post 1970s period when the Free Trade Zone (FTZ) and Licensed Marketing Warehouse (LMW) incentives were introduced (Taylor and Ward 1994). In the interindustry linkage perspective, the sector has strong potential D-Index, indicating that it is potentially a strong engine of growth.

Export is the main market outlet for the products of the Textiles sector, because the population of Malaysia is relatively small and incapable of significantly absorbing its output. In 1982, about 90 percent of textiles products manufactured in the FTZs and LMWs were exported but linking weakly to the domestic system. The sub-sectors textiles and apparel grew by leaps and bounds during the decade 1973-83. However, the sector was badly affected by the 1980s recession (UNIDO 1985). Its vulnerability to markets external to the country had prompted a rethinking by policy makers about promoting the sector. In addition, like the electronics industry, it is a labour intensive sector. The abundance and cheap labour resource of the country mainly propagated its earlier expansion. This advantage has since been eroded when the country developed and reached full employment level of output. In addition, the production activity of this sector takes place in the FTZs, hence isolating its activity from the mainstream economy. It is one of the factors, which had contributed to the relatively slow internalization process of the sector. The linkage between the sector and the rest of the domestic economy is very small. Hence the large disparity (1.70) between potential and realized interindustry linkages.

In the early 1980s, the government of Malaysia had embarked on the promotion of heavy industries as an import substitution strategy, aimed at freeing the rapidly growing economy from

the foreign input dependency. In the sectorial classification, heavy industries include Basic Metals, machinery and transport equipment. From the interindustry linkage perspective, these sectors show strong interindustry linkage strengths as indicated by the high D-Index scores. However, internalization had been low in these sectors. Realized D-Indices show below average values, thereby disqualifying the sector as a realized key sector of the economy.

The failure of these sectors to be identified as realized key sectors is chiefly due to the relatively high foreign input content in the manufacturing process. This is indicated by the relatively large gap between the potential and realized total R-Indices. The large gap, in turn, provides a strong potential for further internalization through the increase in domestic input injection. This can be achieved through the increased domestic manufacturing of the component parts for the machinery and motor vehicles.

Further internalization in these sectors can be a long and difficult process. The supply of certain inputs can be regarded as an impossibility to be satisfied from local sources. In the motor vehicles sector, for example, the large requirement for steel and other metals which is generally not found in this country can never be internalized. Transfer of technology is also a long process. Due to this difficulty, the national automobile industry, the Proton and later the Produa car industry had resorted to joint venture production whereby the manufacturing technology is provided by the foreign partner. This arrangement may hasten the development of the industry compared to the alternative strategy of acquiring the technology and development of domestic components manufacturing facilities, before starting the industry (James et al 1993). This can be a successful strategy, if backed by a strong export sector, which can finance the imports of the intermediate inputs.

In the broad heavy industries sector, internalization is potentially crucial in the area of vehicles and machine parts through the strategy mentioned earlier. The economic advantage from the cheap and abundant labour enjoyed by the country had since been eroded. The strong economic growth of the late 1980s and early 1990s had applied intense pressure on labour supply. Wages had increased and the rate of employment had surpassed full employment levels. Labour importation from neighbouring countries had acted as a safety vent, preventing greater rates of labour wage increases. Under this economic condition, there is great incentive for industries to utilize labour saving technologies. There is a need for local innovations in designing and manufacture of labour-saving devices for use in manufacturing and agricultural production activities.

In the broad services sector, four economic sectors are found to be strong in both the potential and realized interindustry linkages. Hence, the Electricity, Gas, and Steam, Trade, Transport and Storage, Insurance and Business Services are identified as key sectors by the criteria of the D-Index sizes. These sectors, if promoted, would impart strong economic growth stimulus to the economy. In the Electricity, Gas, and Steam sector, further internalization is possible since the gap between potential and realized R-Indices is large. In this sector, the gap mentioned, shows strong traded input content in production. From the D-Index analysis, this sector belongs to the *Power Cluster* which include the sector, Mining and Transport and Storage. These sectors exhibit *enclaved* trading relationship, because they strongly depended on each other for inputs and markets. However, in the production of electricity, gas and steam, there is a strong requirement for imported equipment and parts. The domestic manufacture of these items is a strong potential

for internalization. However, as mentioned earlier, this can be a slow process because it involves the internalization of technology.

6. Conclusion and Recommendations

There are 20 sectors of the Malaysian economy, which possess strong interindustry linkages and can be classified as either potential or *key sectors*. These sectors, when used in an agenda for industrial promotion may impart strong economic growth stimulus to the rest of the economy. They represent sectors, which can provide the fastest growth to the economy from a fixed amount of investment resources.

Of the 20 key sectors, two are in the broad agricultural sector. General Agriculture and Oil Palm Estates exhibit strong interindustrial stimuli to the economy and can be considered to potentially bring about greater rates of economic growth if they are promoted. In the broad manufacturing sector, the key sectors are found to be Oils and Fats, Textiles, Paper and Printing, Industrial Chemicals, Paints etc., Petroleum Products, Rubber Products, Basic Metals, Non-Electric Machinery, Electric Machinery, Motor Vehicles and Other Transport Equipment. Electricity, Gas and Steam, Trade, Transport and Storage, Insurance and Business Services are key sectors in the broad services sector.

Of the key sectors, four groups, called clusters are found to exhibit enclaved trading effects. These are 1) Oils and Fats Cluster: Oil Palm Estates and Oils and Fats; 2) Power Cluster: Mining, Petroleum Products, Electricity, Gas and Steam and Transport and Storage; 3) Industrial Chemicals; and 4) Motor Vehicles. In the clusters Industrial Chemicals and Motor Vehicles, no other sectors are included since they generally trade from within the respective clusters. These clusters, if promoted is recommended to be carried out concurrently with all the cluster members in order to prevent growth impediments due to the development of bottleneck problems.

In some key sectors, growth has been hindered due to structural problems. Internalization process may be accelerated if these structural problems can be removed. Otherwise, the benefits from the exploitation of interindustry linkages may be lost to foreign economies.

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