20 YEARS OF MALAYSIAN ECONOMY: A STRUCTURAL ANALYSIS USING INPUT-OUTPUT APPROACH

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DECLARATION

We hereby declare that:

(1) This undergraduate research project is the end result of our own work and that due acknowledgement has been given in the references to ALL sources of information be they printed, electronic, or personal.

(2) No portion of this research project has been submitted in support of any application for any other degree or qualification of this or any other university, or other institutes of learning.

(3) Equal contribution has been made by each group member in completing the research project.

(4) The word count of this research report is 18559 words .

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LIST OF ABBREVATIONS

GDP	Gross Domestic Product
IMP1	First Industrial Master Plan
IMP2	Second Industrial Master Plan
IMP3	Third Industrial Master Plan
I-O	Input-Output
MSIC	Malaysian Standard Industrial Code
SNA	System of National Account

PREFACE

This Final Year Project is done as the fulfillment of the requirement of our course structure. It contains work done from May 2014 to May 2015. Our supervisor for this project is Dr. Eng Yoke Kee of University Tunku Abdul Rahman. The project has been done solely by the authors, with the reference of other researchers on this similar topic, and we have cited and provided references for our work.

Since 1950s, the studies on the structure of production over time by development economists, especially for developing countries, have served as an important tool to evaluate how far the economy has developed. To some extent, the aim is to identify the 'discernible' patterns of economic development. In Malaysia, the government has carried out important policy reforms to transform the economy during the past two decades. All of these projects and policies are expected to have impact on the structure of production in the economy. Therefore, we come about to engage in this research to examine if the structure of production for the Malaysian economy has changed using the input-output analysis.

In this research, we have measured the inter-industrial linkages effect, analyzed the structure of production, and finally highlighted the key industries and also the potential key industries for the Malaysian economy. The key industries provide the government a channel to stimulate the overall economic growth. All these measures will provide readers a better understanding about the mode of how the economy transforms.

ABSTRACT

Over the period from 1991 to 2010, Malaysian government has undergone a series of policy reforms to transform the Malaysian economy so as to achieve deeper economic integration. Changes in the structure of production prompts concerns about the progress of industrial development and could affect the growth of the overall economy. Therefore, using the latest four sets of Malaysian Input-Output Tables of years 1991, 2000, 2005, and 2010, this paper examines whether the recent policy reforms have caused the structure of production of the Malaysian economy to change. The purpose is to find out the key industries which are crucial for economic planning.

Using the input-output analysis based on Rasmussen unweighted Dispersion Indices, our research shows that the policy reforms implemented by the planners in Malaysia during the period of study have resulted in changes in the structure of production in the Malaysian economy, but the changes are far below the planned target. The key industries vary across the years of study. The secondary sector yields strong linkages with all other industries in the economy. However, more tertiary sectors industries are gaining the significant position in the domestic economy, showing that Malaysia is moving towards a new era during which the economy is led by the growth of service-based industries.

CHAPTER 1: RESEARCH OVERVIEW

1.0 Introduction

The purpose of Chapter One is to provide readers an overall concept of the research subject. It contains the research topic, the background of study, the problem statement, the objective of study, and the significance of study. The outline for each of the chapter in this research is provided at the end of this chapter.

1.1 The Introduction of Structural Analysis

In development economics, structural analysis is concerned with the 'discernible patterns' of economic development. These 'patterns', following economic growth, describe the change in the structure of production in the economy. The structure of production has been defined in various ways by development economists. Generally, it is defined as the significance of the sectors in the economy in terms of output or factor utilization (Soofi, 1992). Over the time, the change in the production structure by which the economy develops show distinct features of the development processes and the mechanism at work (Soofi, 1992). Understanding these processes will allow economic planners to formulate the most appropriate development strategy for the economy.

The development processes may be accomplished in a number of ways. The launch of one new industrial investment will create opportunities for other industries and provide input utilized by other sectors or industries (Bekhet, 2010). Such investment could lead to structural change in the productive sectors of the economy by developing linkages between formerly unrelated industries. However, it takes time for linkage effects to fortify between industries. The progress of this kind of industrial developments can be explained more formally with the concept of Hirschman's inter-industry linkages.

In the economy, production by a certain industry will generate two kinds of economic linkage effects on other industries. They are termed the backward linkage and the forward linkage (Cristobal & Biezma, 2006). The backward linkage effect measures the dependence of one particular industry on other industries from which it purchases inputs; whereas the forward linkage effect measures the dependency of other industries on one particular industry to supply outputs which they use as inputs in their production processes.

Input-output (I-O) analysis is useful for studying these inter-industry linkages. It is a tool to evaluate industries and their relationship to the rest of the economy (Guo & Planting, 2000). Furthermore, the measures of inter-industry linkages provide one mechanism for identifying 'key' industries. A key industry is one whose output growth will promote growth in other industries via its inter-industry linkages. In the economy, a key industry provides a channel for launching industrial program to stimulating regional industrial production through its inter-industries linkages. In this research, we will assess the changes in the structure of production in Malaysia and measure the inter-industrial linkages by applying the input-output approach.

1.2 The Transformation of Malaysian Economy

1.2.1 Background of the Study

As the Malaysian economy has grown, its structure has changed. In fact, the economy of Malaysia has revolved from one dominated by agricultural sectors in the post independent period in the 1960s, to the manufacturing dominated economy during the 1990s, and moving towards to services sectors playing the major role in the economy entering the 21st century. The Gross Domestic Product generated by production in year 2000 has shown an outstanding growth compare to year 1991. Contribution by the primary, secondary, and the tertiary sectors to economic growth has shown significant changes over the period under study, especially the secondary sectors recording a contribution of RM1,048.8 billion in year 2010 compare to only RM165.02 billion in year 1991 (Malaysian Input-Output Table 2000, 2005, ;Malaysian Input-Output Table 2010, 2014). These

indicators reveal that there was a change in the structure of production in the Malaysian economy.

1.2.2 Overview of Malaysia's Major Industrial Policies

i. Heavy Industrialization Programme

The Heavy Industrialization Programme promoted through the 4th Malaysian Plan signaled the important policy shift whereby the government supported the heavy industry development through public sector investments in cooperation with the Domestic Heavy Industries Corporation. The intention of this move was to create and enhance both forward and backward linkages in domestic industry value chains, which in turn led to better integration of industries and higher value-added in the economy. During the time, the industries that received great support from the government were national cars, steel production, petrochemical products and cement industries (Charette, 2006).

ii. First Industrial Master Plan (IMP1)

The First Industrial Master Plan (IMP1) commenced in year 1986 set a foundation for Malaysia's industrial development. The Plan was mainly about the transition from the agriculture-based economy to a manufacture-based one. Twelve industrial sub-sectors were classified to be the focus of development during the plan's implementation period until 1996. The sub-sectors were palm oil, rubber, food, wood-based, chemical and petrochemical, non-ferrous metals, non-metallic minerals, electrical and electronics, transport equipment, machinery and engineering, iron and steel and textiles and apparel (Rethinking the Strategy for the Manufacturing Sector, 2006).

iii. Second Industrial Master Plan (IMP2)

The Second Industrial Master Plan (IMP2), from year 1996 to year 2005, emphasized on fortifying industrial linkages, promoting value-added activities and improving productivity, thereby contributing more to the development of the manufacturing sector. One of the key aspects of the IMP 2 was the government

emphasized on business support services. It also set an elementary basis for, again, fortifying industrial linkages, improving productivity and strengthening competitiveness. The government also liberalized the economy during the IMP 2, thus integrating the economy into the global economy. Over the course of the IMP 2, the manufacturing sector created substantial job opportunities and acted as the second largest source of employment, preceded by the services sector. The IMP 2 also contributed to the development of Small and Medium Enterprises (SMEs), thereby creating a better source of supply to large firms. The IMP 2 also saw a transition of production of catheters and related products, and other medical products to higher value medical devices and products (Ministry of International Trade and Industry, Malaysia, 2006).

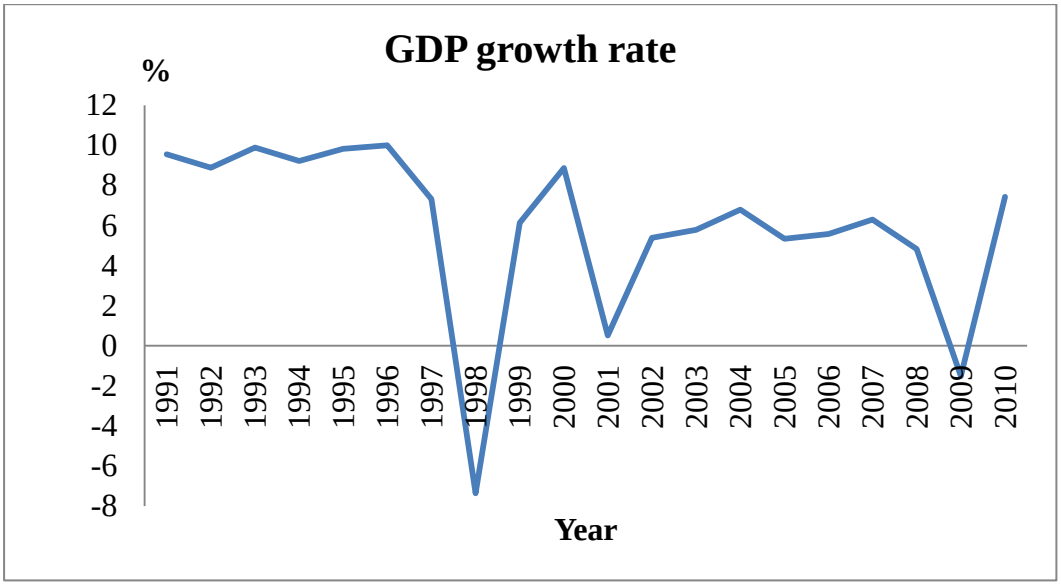
iv. Third Industrial Master Plan (IMP3)

Strengthening competitiveness globally in the long run by changing and bringing innovation to the manufacturing and services sectors was the Third Industrial Master Plan's (IMP3) objective. The manufacturing sector, including agro-based industries and non-government services sector, was under the scope of the IMP 3.

In spite the fact that the manufacturing sector was getting more significant in its role, the service sector has played the most important role in the Malaysian economy all the way along. Like the previous two IMPs, the IMP 3 continued its focus on strengthening competitiveness. Industrialization would be brought to a whole new level by integrating the manufacturing and services sectors. Such a strategy would drive Malaysia towards the goal of a developed nation by 2020. The catalysts that would drive the economy were high value-added activities, the increment of factor productivity, new growth areas, R&D, and the roles of Malaysia's industries and services regionally and globally. Challenges were expected as well over the course of the IMP 3. The challenges included the nurturing of high-skilled workers, the formation of efficient logistic services network, changing to latest technologies and information services, creating a contributive environment for businesses and investments, and the reinforcement of rules and regulations (Ministry of International Trade and Industry, Malaysia, 2006).

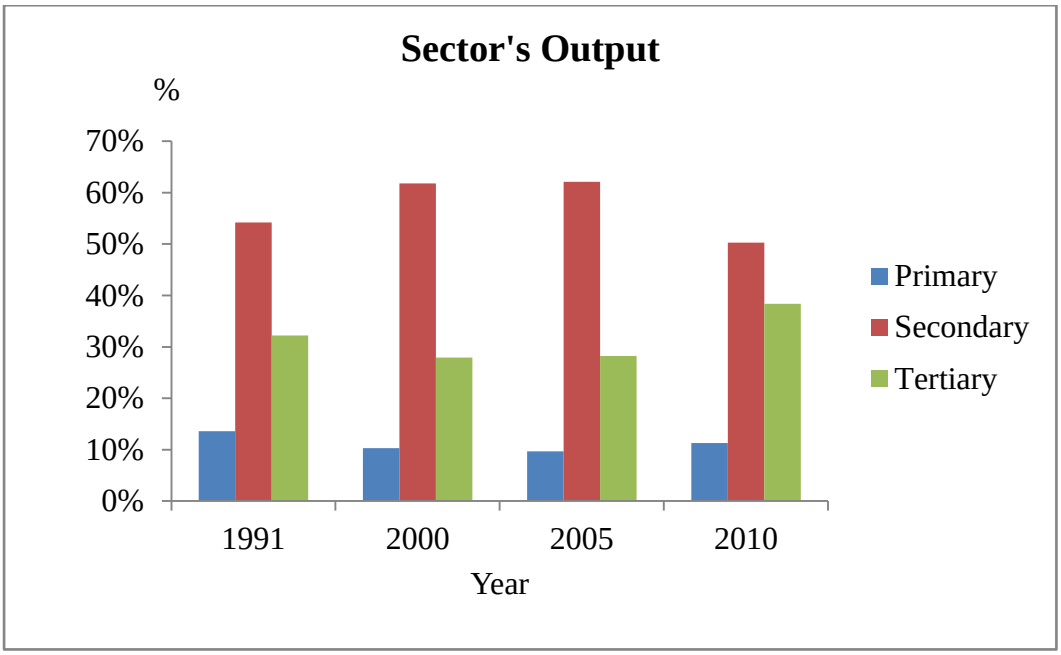
1.2.3 The Trend of Industrial Production in Malaysia

Figure 1.1: Malaysia's Nominal GDP Growth Rate from Year 1991 to Year 2010



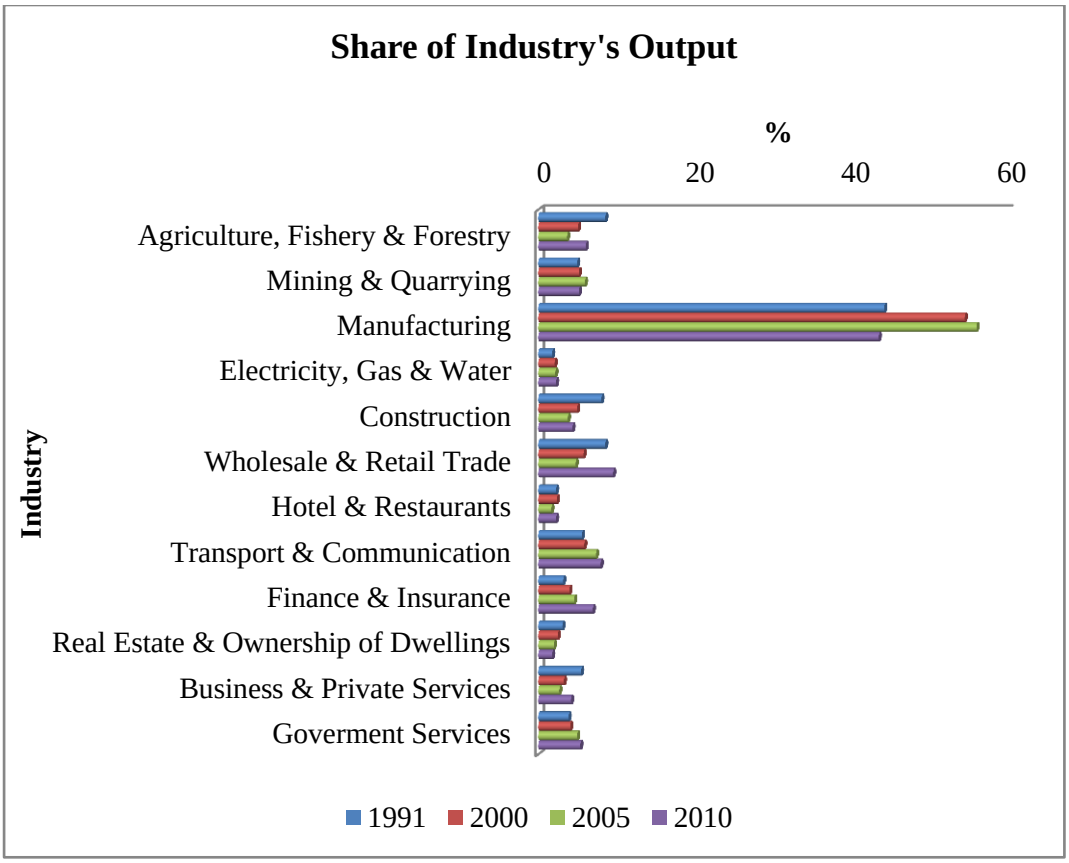
Source: World Databank

Figure 1.2: Share of Sector's Output in Malaysia



Source: Malaysia Input-Output Table 2000 and 2010

Figure 1.3: Share of Industry's Output in Malaysia



Source: Malaysia Input-Output Table 2000 and 2010

Over the period from year 1991 to year 2010, the overall growth by the Malaysian economy has been accompanied by a relatively stable in the share of primary sector's output, a steady decline in the share of secondary sector's output, and a rise in the share of tertiary sector's output. From 1990 to 2000, Malaysia nominal GDP experienced some different movement all along the years (see Figure 1.1). Between year 1990 and year 1997, Malaysia's nominal GDP rate grew at an average rate of 9.21 percent. Due to the 1997 Asian Financial crisis, Malaysia experienced a drastic drop in the nominal GDP to negative 7.36 percent in year 1998. The economy recovered in the early 2000s and achieved a nominal growth rate of 8.86%. Period of high growth was in tandem with manufacturing expansion. The manufacturing sector has become the most significant contributor to the Malaysian economy. The share of manufacturing gross output to total industrial output increased from 44.3 percent in year 1991 to 54.7 percent in year 2000, and is very much higher as compared to other sectors (see Figure 1.3).

The Malaysian economy was in a recession in the year 2001 where the nominal GDP growth rate dropped to 0.52 percent. Malaysia's nominal GDP continued to grow steadily from year 2002 onwards. Between year 2000 and year 2005, the share of the output among the primary, secondary, and tertiary sectors are almost no changes at all (see Figure 1.2), which means the share of output in these three sectors remain relatively constant over the period. Affected by the 2008 global financial crisis, Malaysia's nominal GDP growth rate registered a negative growth rate of 1.51 percent in year 2009 because it affected by the 2008 global financial crisis. The economy bounced back in year 2010 to a positive growth rate of 7.43 percent. For the share of sectoral output, Figure 1.1 shows that the contribution of the secondary sector has dropped and this drop was corresponding to a slight increase in the share of primary sector's output and a larger increase in the share of tertiary sector's output. A more detail information on the share of each economic sub-sectors' output to the total industrial output for year 1991, 2000, 2005, and 2010 is shown in Figure 1.3.

1.3 Problem Statement

In an economy, the interactions between the three sectors (the primary, secondary, and tertiary sectors) play a significant role in the contribution to output growth, which should be considered in analyzing the progress of industrial development. Output growth in one sector is expected to have some economic effects on the output growth of the other sectors. However, the extent to which the growth of each sector can lead to growth in others varies from sector to sector and depends on the structure of the economy (Takahiro & Chu, 2008). In view of this, an analysis of the patterns of industrial production and the interdependency between industries is needed for the understanding of the way the economy operates and its transformations over time (Tounsi, Ezzahid, Alaoui, & Nihou, 2012). This is especially important in developing countries, aim at generating above-average increases in domestic industrial production, and thus stimulating the growth of the overall economy (Cristo′ bal & Biezma, 2006).

Since independence, the planners in Malaysia have mapped out a series of development plans. The primary aim of Malaysian development policy had been to invest in commodities sector, with the rational as to build a solid base for the economy (Bekhet, 2009). As the economy develops over time, it would be expected that substantial structural change would take place in the productive sectors of the economy when more resources are devoted to facilitate economic development towards achieving deeper economic integration and higher value-added in the country (Bekhet, 2010).

Unfortunately, the dualistic industrial structure in Malaysia, which began in the mid-1970s and accelerated throughout the period from 1970s to 1990s, had resulted in a poorly integrated economy in the short run, causing production below maximum capacity and leading to heavy dependence on imports (Bekhet, 2010; Charette, 2006). The problem becomes significant by the late 1980s, as the manufacturing production had been heavily dependent on imported intermediate inputs and capital goods. This was due to the Malaysian government's inability in developing inter-industrial linkages in the domestic value chain (Bekhet, 2010; Charette, 2006). In addition, the high imported content applying to manufacturing production were mainly for export rather than for further domestic value-added

activities, again reflecting the policies' failure to promote deeper economic integration so as to achieve higher value added in the country. Admittedly, the dualistic industrial structure and the excessive dependence on the import of manufacturing inputs for export production were cited as the two critical structural weaknesses among the problem prevailing in the Malaysian economy by the late 1990s (Charette, 2006).

In view of new and emerging challenges facing economic development, Malaysian planners have targeted the period from year 1998 to year 2010 undertake strategic development programmes, aims at ensuring a more sustainable economic development and achieving deeper economic integration (Bekhet, 2009). In the light of this, updated and adequate data would be necessary for keep track of the progress and performance towards reaching the planned targets. Therefore, using the latest datasets, this research is conducted to assess the impact of the implementation of these recent development programs on the structure of production of the Malaysian economy for the period from year 1991 to year 2010, with the objective of identifying the 'key' industries that are crucial for economic planning.

1.4 Research Objectives

1.4.1 General Objective

The general objective of this research is to explore whether the structure of production in the Malaysian economy has changed over the period from year 1991 to year 2010, when many structural projects have been carried out to strengthen domestic industrial linkages, move towards higher value-added activities, and achieve deeper economic integration.

1.4.2 Specific Objectives

i. To measure the inter-industrial backward and forward linkage for Malaysia's industries for the year 1991, year 2000, year 2005, and year 2010, respectively.

ii. To examine the general structure of production of the primary, secondary, and tertiary sector in Malaysia across the year 1991, year 2000, year 2005 and year 2010.

iii. To identify the 'key' industries in Malaysia for the year 1991, year 2000, year 2005, and year 2010, respectively.

1.5 Significance of the study

This research studies the change in the structure of production for Malaysia for the period from year 1991 to year 2010, with the purpose of identifying the 'key' industries which are crucial for economic planning.

The majority of previous studies on the structure of production for Malaysia were restricted to the year 2000 due to the data constraint. Bekhet (2009) has found that the Malaysian economy has experienced substantial structural change in the manufacturing sector in the early 1990s. Besides, Shuja, Yap, Lazim & Okamoto (n.d) has identified the key industries in Malaysia for the year 1983, year 1987, year 1991, and year 2000. With the release of the year 2005 and the year 2010 Malaysian Input-Output Table, there is lack of research that studies the changes in the structure of production for Malaysia for the recent decades. Therefore, using the latest four sets of Malaysian Input-Output Tables released by the Department of Statistic Malaysia, this research aims to contribute to the literature by examining the changes in the structure of production in the Malaysian economy for the period from year 1991 to year 2010.

By examining the inter-industrial linkages, this research provides important insights into what is happening to the production structure of the Malaysian economy during the studied period. Besides, having the knowledge of inter-industry relationship would allow planners and policymakers to monitor and evaluate the progress and the effectiveness of existing development plans. More importantly, they are able to formulate appropriate future development policies that enhance the country's overall economic development.

In addition, this research can be served as a guideline for businesses and investors for making investment decision. By understanding the change in the inter-industry linkages, businesses can obtain the information about the current trend of industrial development and the government's development plan. They will be able evaluate the competitive position of a particular sector in relation to others to look for sectors with potential future growth. This would enhance their future investment planning as well as decision to enter a particular sector.

1.6 Chapter Layout

This research is organized as follows. Chapter One briefs an overall concept for this research. Chapter Two provides a theoretical and empirical review for the I-O approach and the related past studies in this field. Subsequently, Chapter Three describes the methodology and the data used. Chapter Four presents the empirical results and interpretation of the results. Chapter Five concludes the major findings of this research and draws policy implication.

CHAPTER 2: LITERATURE REVIEW

2.0 Introduction

This chapter provides a review for the evolution of the I-O approach, discusses the concept and assumptions of each approach, as well as the limitations and deficiency of each approach on studying the structure of production. Besides, a review for past researches that used I-O analysis in their study is also carried out in this chapter.

2.1 A Review for the Evolution of Input-output Approach

Since the 1950s, comparative studies on the structure of production across nations have received a great deal of attention by development economists, in view of its usefulness in examining the changes in the economic structure over time resulting from economic development (Soofi, 1992). The initial purpose of studying the structure of production is based on the fact that economic sectors are linked to one another through a series of inputs of raw materials and outputs of semi-finished or finished goods and services, so that there are some forms of inter-sectoral or inter-industrial relation between sectors or industries. Wassily Leontief (1936) was the one who found these inter-sectoral relationships in this area. To describe the inter-sectoral relationship, he developed a model which is currently known as the 'Leontief model'. For his contribution, he was entitled to Nobel Prize in the year 1973 (Kim, n.d.).

The Leontief model laid the foundation for the study of production structure of an economy based on the input-output structure of each economic sector. The prevailing approach for input-output analysis and the concept of inter-industrial linkage were based on the ideas initially projected by Leontief (1936).

The $(I-A)^{-1}$ provides the indirect and direct input requirements per unit of final output of a sector. Ghosh(1958) created the supply-driven model that relates

output from various sectors to primary inputs. This model is another approach to the Leontief demand oriented I-O model. It is used to measure forward linkages of sectors of an economy (Temurshoev, 2004). The Rasmussen (1956) calculates backward linkages as the column sum of the Leontief inverse matrix: $(I-A)^{-1}$. Hirschman (1958) suggested the use of forward and backward linkage measures to identify key sectors, which small changes in the sector can accelerate and amplify the whole economy.

Leontief Input-Output Model (1936)

The most common input-output model used to measure how connected or dependent industries are in an economy is the one static quantity model developed by an economist named Wassily Leontief. He gained inspiration from the studies done by classical economists Karl Max and Jean Charles Léonard de Sismondi when he worked on formulating this model. Among the classical economists, Karl Max suggested the economy comprised of two inter-connected departments using a set of tables (Clark, 1984). In other words, a sector has to use its outputs and outputs produced by other industries to make something. The following is the structure of the Leontief model:

$$X = (I - A)^{-1}F$$

Where: A = Matrix coefficients showing the shares of input X_{ij} to total output X_j

X = The column vector of gross output sector

F = The column vector of total final demands

I = An identity matrix

$(I - A)^{-1}$ is called the "*Leontief inverse*".

The above equation can also be identified as the Leontief inverse matrix. The amount a sector needs to buy inputs from suppliers to increase output in order to cope with increases in demand can be shown through the equation. The Leontief

inverse matrix also shows the presence of an increase in output because of an increase in final demand (Sancho, n.d.).

Any changes in final demand, F will have impacts on output, X. The total impact of change in final demand in the economy will be displayed through the Inverse Matrix Table in the Input-Output Tables. The total multiplier shows the magnitude of the increase in aggregate output required to cope with the increase in demand for output caused by the increase in final demand.

Originally developed in the 1930s, it's also a demand-driven model. In other words, the model suggests that insufficiency of factors doesn't exist and demand for outputs is perfectly elastic. Furthermore, prices are not hindered to adjust to changes in final demand due to the absence of factor insufficiency (Reyes & Mendoza, n.d.). Consumers' demand rules the situation while producers adapt to a structure of optimum input. By referring to the Leontief model, one can tell whether an economy is doing productively or otherwise.

One of the major disadvantages of the model is that it assumes that the relationship between inputs and output is linear, that is to say, no constant cost and constant returns to scale. Moreover, input substitution is not allowed by the constant technological coefficients. In reality, the difference between the actual production reactions to changes in final demand and those predicted from input/output calculations can be very big, for example, caused by possible production capability where possible slackness may take place. In addition, increases in production are possible to be eased by the latest technology.

Assumptions for the Input-Output Model:

Since Leontief input-output framework usually encompasses many industries and it is very challenging to analyse and understand. To make matters simple, several assumptions have been made. First, there is only one similar kind of commodity that is produced by each industry. The second assumption is that a constant input ratio for the production of output is utilized by each industry. The third assumption is that production in every industry needs to follow the concept of constant return to scale (constant returns to scale refers to the notion that k times of change in the production of input will result in precisely k times of

change in the production of output). However, these assumptions are not applicable in the real world.

Ghosh Model (1958)

Ghosh Model which is also known as the supply driven model is a model that is formulated by Ambica Ghosh in the year of 1958 to relate the sectoral output to the primary input. The primary input in this model consist of the value added components. This model is also an alternative to the Leontief demand oriented I-O model, and it is commonly used to measure the forward linkages of sectors of an economy (Temurshoev, 2004). Ambica Ghosh noted that the two assumptions in the Leontief model which are a competitive market system and non- scarce resources are implicit and therefore he suggested another version of the model which is now the Ghosh model to identify the interrelationships among industries. He then made some altercation to the assumption which is the direct opposite of what the Leontief's model assumed, which are now fixed allocation coefficients not affected by the change in the final demand, and a scarce capacity for all industrial sectors except the sectors targeted (Park, 2006). There are also four assumptions when running this I-O supply model, and they are Monopoly characteristics, scarcity of inputs, short period, and small region depending much upon other regions. These four criteria should be applied to any case study while using the Ghosh's model in order to examine the applicable possibilities of the supply driven model. In some cases the supply driven model will have a significant implication when an economy depends heavily on imports, because it will be hard for producers to find substitutes in the economy itself. Hence the condition for scarcity is achieved at least during the short run.

The Ghosh or supply driven model is also expressed in viewing the input output table horizontally. In the journal by (Chang, Shin and Lee, 2014), they derived the equation which differs from the demand driven model, where the main difference is demand driven model consist of the final demand of product, while the supply driven demand consist of the final value added by a sector. The demand driven model also consists of the direct input coefficient, while the supply driven model consists of direct output coefficient.

There have been considerable debates on the correct economic interpretation of the input output model. Ghosh's model assumes a centrally planned or monopoly market with scarce resources, where allocation and non-production functions administer and where shortages lead to price rationing and increases.

Although the Ghosh's model is derived on limiting conditions, the critics and debates did not focus on this part, the four conditions assumed when running this model are still reasonable.

The empirical applications since Ghosh's suggestion have not been many, although there have been many possibilities, like cartels, oil shocks, earthquakes, and so on, to apply in the supply-driven model. Meanwhile, the demand-driven I-O model has been widely used for various impact analyses and ever since the various criticisms on the implausibility of the supply side model theoretically, it is tough to find any main studies on the impact analysis. Although Dietzenbacher (1997) showed that the supply-driven or Ghosh's model can be referred as an 'absolute price' model and that the interpretation is easier to understand its price effects than the 'Leontief' (relative) price model, empirical applications still seem to be limited.

Rasmussen Dispersion Indices (1956)

According to Norhayati & Nobuhiro (n.d.), Rasmussen (1956) developed the procedures for calculating inter-industry linkages using the inverse of Leontief I-O tables, $(I - A)^{-1}$ that takes into consideration both the direct and indirect effects of an increase in the output of an industry. Rasmussen's backward linkages are known as power of dispersion index and forward linkages are known as sensitivity of dispersion index. The backward linkages are measured as the column sum of the Leontief inverse matrix: $(I - A)^{-1}$. However, there is a limitation where they were defined in terms of backward linkages only, while the forward linkages are not clearly distinguished.

According to Drejer (2002), initially, the Rasmussen's thesis was concerned with the impacts of price changes on inter-industry relations as expressed by terms of trade. However, the Rasmussen gained his fame through the

development of the power of dispersion index of an industry as a method for identifying key industries. The power of dispersion index describes the relative magnitude to which an increase in final demand for the products of a given industry is dispersed throughout the total system of industries. The power of dispersion index is defined as follows:

$$\sum_i U_{ij} = \frac{1/n \sum_i B_{ij}}{1/n^2 \sum_{ij} B_{ij}}$$

where n is the number of industries, and Σi Bij is the sum of the column elements in the Leontief inverse matrix $B=(I-A)^{-1}$.

This power of dispersion index is used as measurement of backward linkages. It can be interpreted as how much the output from the entire system of industries will increase to cope with the increase in the final demand by one unit for the products of industry *j*.

The sensitivity of dispersion index is defined as:

$$\sum_j U_{ij} = \frac{1/n \sum_j B_{ij}}{1/n^2 \sum_{ij} B_{ij}}$$

where Σj Bij is the sum of the row elements.

This sensitivity of dispersion index is used as a measurement of forward linkages. It can be interpreted as the increase in output in industry i needed to cope with a unit increase in the final demand for the product of each industry in the entire system. The feature of a key industry is the high power of dispersion (and a relatively small value of a standard deviation index), this indicates that the particular industry can contribute evenly to the total system of industries, as it will spread over a relatively large share of the increase of final demand for its outputs to the whole system of industries in general.

The inter-industrial linkages measured through Rasmussen's indices are restricted to demand pull and supply push effects based on changes in final demand. These indices are used to explain the relationship of input and output through demand changes for the final output of a given industry j to other industries in the economic system, because the amount of inputs that is provided

to the directly affected industry j are dependent on the final demand for the outputs produced by industry j.

The discussion of how an I-O system emerges can be used to explain the linkage effect. This is shown by the way where Hirschman explained Rasmussen's index of power of dispersion. Assuming for every industry that the country's development began with, as a measure of backward linkages based on a mental experiment, all the industry's sale and purchase transactions with other domestic industries are imagined to have developed as a sequel to the foundation of the industry.

According to Norhayati, B & Nobuhiro (n.d.), there are basically two approaches under Rasmussen (1956), namely the Rasmussen Unweighted Approach and Rasmussen Weighted Approach. The basic idea of the Rasmussen Unweighted Approach is all industries are of equal importance in the economy. Therefore, there is no weightage being included when calculating the forward and backward linkages.

Under the Rasmussen Weighted Approach, Laumas (1976), Jones (1976) and Hazari (1970) proposed the use of the weighting scheme in the backward and forward linkages so as to eliminate the downside of the method that was developed by Rasmussen to identify key sectors. The weightage for the backward linkages is the share of sectors in final demand while the weightage for forward linkages is the primary inputs (value added).

The basic idea of the Rasmussen Weighted Approach is to take into account the relative importance of each sector in terms of final demand or primary inputs.

Example for the weightage that is based on final demand:

$$k_{ij}{}^{w} = \frac{kij\ Fi}{\sum_{i=1}^{n} Fi}$$

$k_{ij}{}^{w}$ is the weighted ij^{th} element of Leontief inverse matrix

k_{ij} is the ij^{th} element of Leontief inverse matrix

F_i is the final demand

Example for the weightage that is based on value added:

$$g_{ij}^{w} = \frac{gij\ Vj}{\sum_{j=1}^{n} Vj}$$

g_{ij}^{w} is the weighted ij^{th} element of Ghosh inverse matrix

g_{ij} is the ij^{th} element of Ghosh inverse matrix

V_j is the value added

Hence, the forward and backward linkages can be expressed as:

$$BL_j^{w} = \sum_{i=1}^{n} k_{ij}^{w} = B_{\cdot j}^{w}$$

and

$$FL_i^{w} = \sum_{j=1}^{n} g_{ij}^{w} = B_{i\cdot}^{w}$$

Hirschman's Concept of Inter-Industrial Linkages (1958)

According to Drejer (2002), the backward and forward linkages were first explored by Hirschman (1958). He was a development economist with some particular interest in Latin American countries. The Strategy of Economic Development (1958) was the one that introduced the backward and forward linkage concepts. It was founded based on the experiences gained as a private consultant and official advisor in Columbia. This concept theory turned out to have general applicability.

Generally, the linkage concept is expressed as a linkage between the on-going and the new activity. The effects of backward linkage are associated to derived demand, such as the supply of input for a particular activity. The effects of forward linkage are correlated to output utilization, such as the outputs from a particular activity that will be used as inputs in some other new activities.

Recent Development for I-O Analysis

In the recent year, the original framework of input-output analysis for the structure of production has been extended to incorporate more complicated economic scenarios so that the empirical results can better reflect the reality. This includes the use of the structural decomposition technique within the input-output framework to analyze the change in economic structure based on the decomposition of the source of growth factors. Pioneer study that used this approach was the study on the source of change in air pollution emissions performed by Leontief & Ford (1972). Began in the mid-1970s, Skolka's (1977) carried out his work on structural decomposition analysis and concluded with the extended set of estimating equations in his paper.

A more recent development for input-output analysis refers to the measures of industry interconnectedness projected by Soofi (1992). In his paper, he proposed the use concentration ratios that focus only on the level of purchase and sale transaction between industries to measure the pure relationship between industries and their interconnectedness.

2.2 A Review for Past Studies on the Structure of Production

Since 1950s, input-output approach has been widely used in both developed and developing countries to study the structure of production. Eddine (n.d.) has studied the development strategy for the Algerian economy in the 1980s and 1990s using input-output linkages analysis. Claus (2002) has examined the structure of production of New Zealand economy using input-output analysis. Cristobal & Biezma (2005) use input-output analysis to measure the linkages of the mining and quarrying industry in the European Union (EU) and to determine the key sectors.

Kamaruddin (2008) performed a study on the source of growth and key sectors in Malaysia through the input-output approach. In his research, he applied the decomposition method and Rasmussen dispersion indices to analyze the structure of production of the Malaysian economy across three sets of Malaysian input-output tables, which are the I-O 1978, 1991, and 2000. The key finding of this study is that most of the sectors induced its supplying production mainly for domestic market.

Similar to Kamaruddin (2008), Bekhet (2009) used a structural decomposition technique to explore the various and decomposition of changes in the structure of Malaysian economy for the period from year 1983 to year 2000. In this research, the author used the four sets of Malaysian input-output tables, which are the year 1983, year 1987, year 1991, and year 2000, to examine the changes in the economic structure with different degrees of development over the period under the study. Bekhet (2009) found that over the time, there are similarities in the structure of production of intermediate use of goods and services in the Malaysian economy.

Besides, Bekhet (2010) analysed the production structure change in the Malaysian economy through the ranking sector approach. He studied for the year 1983, 1987, 1991, and 2000. In his research, he applied the unweighted approach of the Rasmussen dispersion indices to measure the backward and forward linkage for each economic sector. Besides, the coefficients of variations for forward and

backward linkages are calculated to take into account the dispersion of each sector's stimulus on one another. After that, the sectors are then ranked based on their linkages values to show the relative importance of each sector in the economy. The results based on the ranking of the sectors are then used to identify the key sectors in the Malaysian economy.

Compare to Bekhet (2010), Shuja et al. (n.d.) used both weighted and unweighted approaches of the Rasmussen dispersion indices to analyse the structure of production and identify the key sectors of the Malaysian economy for the year 1983, 1987, 1991, and 2000. They found that there are significant differences between the results obtained based on the weighted and unweighted approaches. Compared with the unweighted approach, the weighted approach tends to identify more key sectors for each studied year. However, Shuja et al. (n.d.) did not consider the coefficient of variation when identifying the key sectors.

Lenzen (2002) made use of the identification and ranking of paths, made more understandable the structural path analysis supplies detailed decompositions into the objects of both linkages and fields of influence. Economic landscapes mapping fields of influence come in handy when used to catch in one image of the interdependence of industries in economies, the crucial prerequisites and sales and also the changes that take place when different production factors are evaluated. The comparative crucial sector analysis in monetary and environmental terms is applicable in planning environmental policies and carrying out analyses.

Tounsi et al. (2012) suggested that the search for the structural characteristics and sectoral interdependences of and within an economy is important for the understanding of how its modes function and of how its transformations take place over time. The input-output analysis is commonly utilized to achieve this objective. Moreover, information suggested by the Leontief inverse matrix comes in handy when used to identify key sectors. This identification may provide a guideline for policy makers in planning effective industrial strategies. In this paper, the identification of productive sectors is carried out with the use of the unweighted Rassmussen approach. The sequencing of sectors is dependent upon how intensive their links are with other sectors. Two results need to be emphasized. First, the number of key sectors within the

economy of Morocco reduced to two in 2007 instead of four in 1998. Second, the sequencing of sectors results very sensitively from the accuracy of the data and from the year in which the identification is carried out.

Haji (1987) said that an empirical identification of key sectors is required in order to ascertain priorities of sectors in the planning of developing countries within their respective nations as well as the effective apportionment of development attention. It is the aim of a particular research paper to accumulate and show quantitative measures while taking this object into consideration in the future. Four different methods based on input-output data could be considered when focusing on structural interdependence of production. The first method is the comparison of intermediate transactions with total production and demand. The second method is the adjustment of the first method to allow for indirect effects. The third method is the determination of the power of dispersion, which focuses on the measure of backward linkages. The fourth and the last one is triangulation. The triangulation approach can be used not only in studying inter-industrial transaction within an economy, but also in comparing the performance of different economies.

2.3 Conclusion

In this chapter, a review for various I-O approaches for studying production structure changes in the economy is provided. For this research, the methodology used will largely follow the concept proposed by Rasmussen, which is the Rasmussen Dispersion Index. The unweighted approach is chosen and applied to the Malaysian economy to analyze the changes in the structure of production over the period of study and identify the key industries for the year 1991, 2000, 2005 and 2010, respectively.

CHAPTER 3: RESEARCH METHODOLOGY

3.0 Introduction

Chapter Three describes the research methodology. It consists of two sections. The first section discusses the theoretical framework and the methodology used in this research. Subsequently, the second section describes the data used in this research, including the source and the characteristic of the data. The data processing approach is also discussed under this section.

3.1 Input-Output Methodology

I-O analysis studies the inter-relationship between the productive sectors of the economy through the measures of inter-industrial linkages. Generally, inter-industrial linkage measures are derived from the input-output table as shown in Table 3.1.

Table 3.1 Typical Input-Output Table

Input-output table	**Intermediate demand (Zj), sectors (j = 1, 2, 3, ……, n)**	**Final demand (Y_i)**		**Total output (X_i)**
		Domestic	Export	
sectors (i = 1, 2, 3, ……, n)	z_{11} ……z_{1j} z_{21} ⋮ z_{i1}……..z_{ij}			X_1 X_2 X_3 . . . X_n
Imports (M_j)				
Value added (V_j)				
Total inputs (X_j)	X_1 X_2 X_3…… X_n			

Table 3.1 displays a typical 'industry by industry' I-O table. It summarizes the distribution of goods and services between the sectors in an economy. It presents, in rows, the intermediate and final demand for goods and services, and, in columns, the input or the cost structure of economic sectors in the economy.

From the horizontal row view, the value of total production (X_i) of i^{th} industry is the sum of intermediate demand (z_{ij}) and final demand (Y_i). This relationship can be expressed as:

$$X_i = \sum z_{ij} + Y_i \quad (1)$$

Where $\sum z_{ij}$ is the supply of input from industry i to all industry j in the economy, and Y_i is the final demand.

From the vertical column view, the total input (X_j) of j^{th} sector is the sum of intermediate demand (z_{ij}) and value added (V_j), which can be expressed as:

$$X_j = \sum z_{ij} + V_j \quad (2)$$

Where $\sum z_{ij}$ is the amount of input industry j supplies to all industry j in the economy for their own production, V_j is the value added or primary input.

3.1.1 Input and Output Coefficients

In order to perform linkages analysis, we will start with the input coefficient a_{ij} and output coefficient $\vec{a}_{ij}$. Basically, an input-output model is a system of linear equations. This allows us to express the transactions in the I-O table as follows:

$$z_{11} + z_{12} + \ldots. + z_{1j} + Y_1 = X_1$$

$$z_{21} + z_{22} + \ldots. + z_{2j} + Y_2 = X_2$$

$$\ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots$$

$$z_{i1} + z_{i2} + \ldots. + z_{ij} + Y_i = X_i \quad (3)$$

Equation (3) is the extension of Equation (1) and is written based on the vertical column view of the input-output table. Similarly, we can express the extension for Equation (2) by transposing the vertical column view to a horizontal view one.

Input Coefficient

In the framework of an input-output analysis, the input coefficient provides information on the input structure for a specific industry (Shuja et al., n.d.). It measures, for an industry to produce a dollar's worth of output, how much inputs it directly required from other industry. From the input-output table (See Table 3.1), the input coefficient is derived by dividing each column of z_{ij} by the total input of industry j (X_j) associated with that column, it is defined as follows:

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

Output Coefficient

On the other hand, the output coefficient links the sectoral output to primary input. It measures the amount of an industry's output that enters the inter-industry system as input for other industries rather than delivering for final demand. From the input-output table (see Table 3.1), the direct output coefficient is computed by dividing each row of z_{ij} by the total output (X_i) of industry i associated with that row. It is expressed as follows:

$$\vec{a}_{ij} = z_{ij} / X_i \quad (5)$$

3.1.2 Input and Output Leontief Inverses

Input Leontief Inverse

The Input Leontief Inverse can be derived from the demand-driven model proposed by Leontief (1936). It measures, for a sector to produce a dollar worth's of its output, how much of input it directly and indirectly required from other sectors.

Based on Equation (4), z_{ij} represents the input required by sector j from sector i, thus, the total unit of input from sector i required to produce X_j units of

sector j's output is $a_{ij}X_j$. This relationship can be shown by rearranging equation (4) as:

$$z_{ij} = a_{ij}X_j$$

Substituting Equation (6) into Equation (1), Equation (1) can be rewritten as follows:

$$a_{11}X_1 + a_{12}X_2 + \ldots. + a_{1j}X_j + Y_1 = X_1$$

$$a_{21}X_1 + a_{22}X_2 + \ldots. + a_{2}X_j + Y_2 = X_2$$

$$a_{31}X_1 + a_{32}X_2 + \ldots. + a_{3j}X_j + Y_3 = X_3$$

$$\ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots$$

$$a_{i1}X_1 + a_{i2}X_2 + \ldots. + a_{ij}X_j + Y_i = X_i \qquad (7)$$

Equation (7) describes a demand-driven model by viewing the input-output table vertically. If we treat the final demand (Y) as exogenous variable:

$$X_1 - a_{11}X_1 - a_{12}X_2 - \ldots. - a_{1j}X_j = Y_1$$

$$X_2 - a_{21}X_1 - a_{22}X_2 - \ldots. - a_{2j}X_j = Y_2$$

$$X_3 - a_{31}X_1 - a_{32}X_2 - \ldots. - a_{3j}X_j = Y_3$$

$$\ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots$$

$$X_i - a_{i1}X1 - a_{i2}X_2 - \ldots. - a_{ij}X_j = Y_i \qquad (8)$$

Or

$$(1 - a_{11})X_1 - a_{12}X_2 - \ldots. - a_{1j}X_j = Y_1$$

$$- a_{21}X_1 + (1 - a_{22})X_2 - \ldots. - a_{2j}X_j = Y_2$$

$$- a_{i1}X_1 - a_{i2}X_2 - \ldots. + (1 - a_{ij})X_j = Y_i \qquad (9)$$

In matrix notation,

$$\begin{pmatrix} (1 - a_{11}) & - a_{12} & \dots & - a_{1j} \\ -a_{21} & (1 - a_{22}) & \dots & - a_{2j} \\ -a_{i1} & - a_{i2} & \dots & (1 - a_{ij}) \end{pmatrix} \begin{pmatrix} X_1 \\ X_2 \\ X_3 \end{pmatrix} = \begin{pmatrix} Y_1 \\ Y_2 \\ Y_3 \end{pmatrix}$$

$$(I - A)X = Y$$

$$X = (I - A)^{-1}Y \tag{10}$$

Where I is the identity matrix, and $(I - A)^{-1}$ is called the input Leontief Inverse. Denote b_{ij} as the element of $(I - A)^{-1}$, the column sum of the element of input Leontief Inverse forms the element of backward linkage effect:

$$B_{\bullet j} = \sum b_{ij} \tag{11}$$

Output Leontief Inverse

The Output Leontief Inverse can be derived from the supply driven model formulated by Ghosh (1958). It measures how much of an industry's output need to be increased in order to cope with a unit increase in the final demand for other industries' products.

Based on Equation (5), we know that $\vec{a}_{ij}$ is the amount of input sector i supplies to all industry j for their own production. Hence, the total sale of input from industry i for industry j's production is $\vec{a}_{ij}X_i$. This relationship can be seen by rearranging Equation (5) as follows:

$$z_{ij} = \vec{a}_{ij} X_i \tag{12}$$

By substituting Equation (12) into Equation (2), we can derive the supply-driven model as:

$$X_j = \sum \vec{a}_{ij} X_i + V_j \tag{13}$$

Or in matric notation:

$$X_j = \vec{A}X \quad + V_j$$

$$X' = (I - \vec{A})^{-1}V \tag{14}$$

Where V is the vector of value-added and $(1 - \vec{A})^{-1}$ is the output Leontief Inverse from the horizontal row view. The prime (') indicates the transpose of the matrix. Denotes $\vec{b}_{ij}$ as the elements of $(1 - \vec{A})^{-1}$, the row sum of the element $\vec{b}_{ij}$ of Output Leontief Inverse forms the element of forward linkage effect:

$$B_{i\bullet} = \sum \vec{b}_{ij} \tag{15}$$

3.1.3 The Backward and the Forward Linkages

The concept of backward linkage can be explained more easily by an example. Suppose there is an industry, namely j, increases its production, this indicates that it will increase demand on the industries whose outputs are used as inputs to the production in industry j. This relationship shows the direction of causality between industries in the demand-driven model. This kind of interdependency of one particular industry on those industries from which it purchases inputs is termed the backward linkage effect (Zhang & Felmingham, 2002). The higher is the value of backward linkage for an industry, the larger the industry's dependence on other industries' input product in the economy, and therefore the increase in this industry's production might have a greater stimulation effect to the entire economy (Cristobal & Biezma, 2006).

Similarly, the concept of forward linkage can also be explained by an example. Suppose there is an industry, namely i, increases its supplies to other industries, this means that there will be more industry i's output available for industries which used industry i's output as input in their production process. This relationship shows the direction of causality between industries in the supply-driven model. This kind of interdependency of one particular industry on those industries to which its output is sold is termed the forward linkage effect (Zhang & Felmingham, 2002). The higher is the value of forward linkage for an industry,

the greater is the stimulation effect this industry might receive from an increase in the production of other industries (Cristobal & Biezma, 2006).

The Equation (11) and the Equation (15) are the elements for backward and forward linkage, respectively. Both of these linkages are an average stimulus generated by each industry in the supply driven model and the demand driven model. To allow inter-industry comparison, a normalization procedure for the results for both linkages is often carried out by relating the average stimulus generated by sector i represented by row and sector j represented by column to the global average:

$$\bar{b} = \sum_{ij} b_{ij} / n^2 \quad (16)$$

The global average measures the average stimulus for the entire economy when all final demands increase by unity. The normalized backward and forward linkages are expressed as an index:

$$U_{i\cdot} = B_{i\cdot} / \bar{b} \quad (17)$$

$$U_{\cdot i} = B_{\cdot j} / \bar{b} \quad (18)$$

Equation (17) is known as the Power of Dispersion Index and it is a measure of backward linkage effect; whereas equation (18) is known as the Sensitivity of Dispersion Index and it is a measure of forward linkage effect. In an economy, a key sector is classified by both the backward linkage and the forward linkage greater than one, $U_{i\cdot} > 1$ and $U_{\cdot i} > 1$. A sector with both linkages over one implies that the increased production of the sector has both an above-average stimulus and influence on all other sectors. In this research, we will use Equation (17) and Equation (18) for our analysis.

3.1.4 Coefficients of Variation

The Power of Dispersion and the Sensitivity of Dispersion Indexes are essentially an average measure of inter-industry relationship. They are sensitive to extreme value. High value of forward or backward linkage could be the result of selling or buying large amount of output or input to or from a few industries. Therefore, using these two indexes would not be sufficient to determine the key industry as they do not take into account the dispersion of the stimuli. To account for the extreme value, Lenzen (2002) suggested taking into account the measures of coefficients of variation for forward and backward linkage. The two measures are expressed as:

$$V_{i.} = \frac{[(1/n\text{-}1) \sum (b_{ij} - 1/n\, b_{i.})^2]^{1/2}}{(1/n)\, b_{i.}} \quad (19)$$

$$V_{.j} = \frac{[(1/n\text{-}1) \sum (b_{ij} - 1/n\, b_{.j})^2]^{1/2}}{(1/n)\, b_{.j}} \quad (20)$$

Where the Equation (19) represents the coefficients of variation for forward linkage, and the Equation (20) represents the coefficient of variation for backward linkage. Therefore, an additional criterion for key industry is that coefficients of variation are relatively low.

3.2 Data Sources

This research used secondary data which are the four sets of Malaysian input-output tables of the year 1991, 2000, 2005, and 2010. All the tables are sourced from UTAR Library Database and from the website of Department of Statistic Malaysia. The Department of Statistic Malaysia is the organization which compiles and publishes the input-output tables in Malaysia.

The concept and definition used in the compilation of the 1991 I-O tables follows the recommendations by United Nations in the System of National Account 1968 (SNA 1968). The table includes ninety-two industries and is based on the national accounts classification. Compare with 1991 tables, the 2000 I-O tables follow two version of System of National Account, which are SNA 1968 and SNA 1993. The size of the tables increase to ninety-four industries and it is based on the Malaysia Standard Industrial Classification 2000 (MSIC 2000).

Furthermore, the 2005 I-O tables are based on the System of National Account 1993 and Handbook of Input-Output table Compilation and Analysis 1999 published by United Nations. To satisfy industries' interest and accommodate users' need, the size of the tables has been increased to one hundred and twenty industries and it is based on the MSIC 2000. The latest 2010 I-O tables, which is a more refined version in terms of valuation for the commodities and industries compare to previous I-O tables, are based on the System of National Accounts 2008 (SNA 2008). Based on the Malaysia Standard Industrial Classification 2008, the size of the table has been expanded to one hundred and twenty four industries.

All the transactions in input-output tables are in millions of Ringgit Malaysia and recorded at basic prices. At basic price transactions are valued at the price received by the producers for a unit of commodity produced. For consistency and comparison purpose, the original input-output tables consisting of different number of industries are reclassified into fourty-five industries in this study by referring the Malaysian Standard Industrial Code 2000 (MSIC 2000) and 2008 (MSIC 2008). The reclassification of the industries is shown in Table 3.1.

Table 3.2: Reclassification of Industry

No	Name of Industry	Year			
		1990	**2000**	**2005**	**2010**
1	Agriculture products and others	1,4,5	1,4,5	1-4,7,8	1-4, 7, 8
2	Rubber planting	2	2	5	5
3	Oil palm estates	3	3	6	6
4	Livestock farming	6	6	9, 10	9, 10
5	Forestry and logging	7	7	11	11
6	Fishing	8	8	12	12
7	Crude oil and natural gas	9	9	13	13
8	Mining and quarrying	10,11	10,11	14-16	14-16
9	Food and beverage	12-15, 17-21, 23-24	12-15, 17-21, 23-24	17-20, 22-25,27-28	17-20, 22-25,27-28
10	Oil and fats	16	16	21	21
11	Animal feeds	22	22	26	26
12	Tobacco	25	25	29	29
13	Textile	26-28	26-28	30-32	30-32
14	Clothing	29	29	33	33
15	Leather and footwear	30,31	30,31	34-35	34-35
16	Wood product	32,33	32,33	36-40	36-40
17	Furniture and paper products	34,35	34,35	41	41
18	Publishing and printing	36	36	42-43	42, 43
19	Petroleum refinery	42	42	44	44
20	Chemical products and others	37-38, 40-41	37-38, 40-41	45-47,49-50	45-47,49-50
21	Drugs and medical product	39	39	48	48
22	Processed rubber and rubber products	43,44	43,44	51-54	51-54
23	Plastic Products	45	45	55	55
24	Non-metallic mineral products	46-49	46-49	56-59	56-59
25	Basic metal	50,51	50,51	60-62	60-62
26	Fabricated metal products	52-54	52-54	63-64	63, 64
27	Industrial machinery and equipment	55	55	65-67	65-67
28	Household machinery and equipment	56	56	69	69
29	Household electric appliance and apparatus	57-59	57-59	68, 70-75	68, 70-75
30	Precision equipment	64	64	76-79	76-79
31	Motor vehicle	61	61	80	80
32	Other transport equipment	60,62,63	60,62,63	81,82,83	81-83
33	Other manufacturing products	65	65	84,85	84, 85
34	Electricity, gas, and waterworks	66,67	66,67	86,87	86-88
35	Building and construction	68	68	88-91	89-92
36	Wholesale and retail trade	69	69	92	93
37	Hotels and restaurants	70	70	93,94	94, 95
38	Transportation services	71	71	95-100	96-101
39	Postal and telecommunication services	72	72	101	102-105
40	Financial services	73-75	73-75	102-105	107-110
41	Real estate and ownership of dwellings	76,77	76,77	106-107	111-112
42	Business services	78	78	108-112	106, 113-116
43	Education services	79	79,80	114	118
44	Healthcare services	80	81,82	115	119
45	Other services	81-92	83-94	113, 116-120	117, 120-124

Sources: Malaysia Input-Output Table 1991, 2000, 2005, and 2010.

3.3 Conclusion

In this chapter, the theoretical framework and methodologies used for the research are discussed, followed by data description and processing. The next chapter will examine the structure of production for the Malaysian economy over the period from year 1991 to year 2010, by applying the inter-industrial linkage measures developed in this chapter.

CHAPTER 4: RESEARSH RESULTS AND INTERPRETATION

4.0 Introduction

This chapter presents the empirical results for this research. It is structured into three sub-sections. The first section reports the measures of inter-industrial forward and backward linkage for the Malaysian industrial sub-sectors for the year 1991, year 2000, year 2005, and year 2010, respectively. All the measures are calculated by Microsoft Excel using the transactions coefficient matrices in the industry by industry input-output table for the Malaysian economy. Subsequently, the second section extends the inter-industrial linkage measures to the analysis of the structure of production for the primary sector, the secondary sector, and the tertiary sector of the Malaysian economy over the period of study. Lastly, the third section is the identification of the key industries for the four studied years for the Malaysian economy by referring the two criterions specified in Chapter Three.

4.1 Measures of Forward and Backward Linkages

Table 4.1 Sensitivity of Dispersion Index – Forward Linkage

No.	Industry	Year			
		1991	2000	2005	2010
1	Agriculture products and others	0.9461	**1.0552**	**1.2124**	0.9019
2	Rubber planting	**1.2197**	**1.2943**	0.7696	0.7843
3	Oil palm estates	**1.4286**	**1.6386**	**1.5990**	**1.5605**
4	Livestock farming	**1.0285**	**1.0635**	**1.4247**	0.6763
5	Forestry and logging	0.9952	**1.1828**	**1.2322**	**1.6007**
6	Fishing	0.9504	**1.0730**	0.8626	0.8905
7	Crude oil and natural gas	0.9784	0.9781	**1.0554**	**1.1630**
8	Mining and Quarrying	**1.3689**	**1.4988**	**1.2094**	**1.5639**
9	Food and beverage	0.8221	0.9749	0.7870	0.8043
10	Oil and fats	**1.2001**	**1.4193**	**1.1165**	**1.0192**
11	Animal feeds	**1.7122**	**1.6805**	**1.1076**	**1.1012**
12	Tobacco	0.7326	0.6647	0.8700	0.6635
13	Textile	0.8203	0.8890	0.9379	0.8420
14	Clothing	0.6792	0.7407	0.7246	0.7235
15	Leather and footwear	0.6563	0.8045	0.8856	0.9356
16	Wood product	0.8297	0.8560	0.8447	**1.0159**
17	Furniture and paper products	**1.1001**	**1.0196**	**1.0109**	0.9365
18	Publishing and printing	**1.3662**	0.9666	**1.0130**	**1.5447**
19	Petroleum refinery	**1.2099**	**1.1315**	**1.2945**	**1.0208**
20	Chemical products and others	0.9398	**1.0768**	0.9421	**1.1187**
21	Drugs and medical product	**1.1250**	0.8290	0.8929	**1.1038**
22	Processed rubber and rubber products	0.7575	0.8856	**1.2960**	**1.1166**
23	Plastic Products	**1.0247**	0.8205	**1.0272**	0.9661
24	Non-metallic mineral products	**1.2922**	**1.2497**	**1.1837**	**1.3343**
25	Basic metal	**1.2104**	**1.1110**	**1.0969**	**1.2108**
26	Fabricated metal products	**1.0273**	**1.2275**	**1.1532**	**1.0911**
27	Industrial machinery and equipment	**1.1848**	0.9111	0.8736	0.7891
28	Household machinery and equipment	0.7524	0.6684	0.6482	0.5991
29	Household electric appliance and apparatus	0.7548	0.7150	0.7842	0.6040
30	Precision equipment	0.6496	0.7050	0.7577	0.6671
31	Motor vehicle	0.8170	0.9092	0.7619	0.8927
32	Other transport equipment	**1.1678**	**1.0991**	0.7848	0.7586
33	Other manufacturing products	0.9328	0.9404	**1.1646**	**1.1954**
34	Electricity, gas, and waterworks	**1.3246**	**1.3821**	**1.1755**	**1.3514**
35	Building and construction	0.7073	0.7096	0.8773	0.7683
36	Wholesale and retail trade	**1.0580**	**1.2448**	**1.1797**	0.9837
37	Hotels and restaurants	0.8949	0.9540	0.8470	0.8404
38	Transportation services	**1.0249**	0.9637	**1.1888**	**1.1258**
39	Postal and telecommunication services	**1.1869**	0.9635	**1.1444**	**1.1304**
40	Financial services	0.8217	0.7265	**1.3475**	**1.3703**
41	Real estate and ownership of dwellings	0.9081	0.8935	0.9088	**1.0398**
42	Business and private services	**1.3911**	**1.0739**	**1.0459**	**1.3240**
43	Education services	0.6440	0.6404	0.5581	0.5957
44	Healthcare services	0.6456	0.6449	0.7182	0.6728
45	Other services	0.7125	0.7230	0.6841	0.6016

Table 4.1 presents the Sensitivity of Dispersion Index for industries in Malaysia. It is constructed by applying Equation (18) derived in Chapter Three and it is a measure of forward linkage. The forward linkage measures the increased output from an industry needed to cope with a unit increase in the final demand for all industries' output. The higher the value of forward linkage for an industry, the more influence the industry has on other industries' production through its inputs supplied. In other words, a greater than one forward linkage indicates that the industry has an above-average influence on other industries' production. It also indicates strong forward linkage effect.

Referring Table 4.1, the first column of the table shows the number of industry, the second column shows the name of the industry, and the third column is the Sensitivity of Dispersion Index for Forward Linkage for each column of industry for the year 1991, year 2000, year 2005, and year 2010, accordingly. For each year, and for each column of industry, the forward linkage values that are greater than one are bold and highlighted in blue color.

Over the period from year 1991 to year 2010, it is shown that the number of industry having above-average influence has been more fluctuating. From twenty one numbers of industries in year 1991, it decreased to nineteen in year 2000. Then, it increased to twenty three in year 2005, and reduced slightly to twenty two in year 2010. Generally, it is difficult to justify whether there have been more industries or fewer industries playing more role as suppliers of inputs to other domestic industries for their own production, as the range of changes is very small.

After having an overview for the inter-industrial forward linkage, the next section shall look at the measure of the Power of Dispersion Index for Backward Linkage for industries in Malaysia.

Table 4.2 Power of Dispersion Index – Backward Linkage

No.	Industry	Year			
		1991	2000	2005	2010
1	Agriculture products and others	0.8375	0.8420	0.8810	0.7191
2	Rubber planting	0.7429	0.7243	0.7525	0.8895
3	Oil palm estates	0.7376	0.8544	0.8248	0.7625
4	Livestock farming	**1.4117**	**1.4346**	0.9925	**1.0272**
5	Forestry and logging	0.7492	0.7942	0.6820	**1.2166**
6	Fishing	0.8793	**1.0661**	0.9024	**1.0546**
7	Crude oil and natural gas	0.7403	0.7173	0.7034	0.6850
8	Mining and Quarrying	0.9636	0.9583	**1.0834**	0.7645
9	Food and beverage	**1.2701**	**1.2470**	**1.1293**	**1.0785**
10	Oil and fats	**1.7806**	**1.9489**	**1.4791**	**1.5283**
11	Animal feeds	**1.0451**	0.9600	0.9699	**1.0574**
12	Tobacco	**1.0406**	0.9126	**1.0684**	0.7823
13	Textile	0.9555	**1.0342**	**1.1056**	**1.0552**
14	Clothing	0.8869	**1.0357**	0.9360	0.9145
15	Leather and footwear	0.9495	**1.1941**	**1.0078**	**1.0034**
16	Wood product	**1.2980**	**1.2281**	**1.0554**	**1.4404**
17	Furniture and paper products	**1.0614**	**1.0876**	**1.0803**	**1.1985**
18	Publishing and printing	0.9099	**1.0670**	0.9881	0.9942
19	Petroleum refinery	**1.3149**	**1.0595**	**1.1205**	0.9890
20	Chemical products and others	0.9768	**1.1830**	**1.0652**	**1.1388**
21	Drugs and medical product	**1.0359**	**1.0164**	**1.0846**	0.8102
22	Processed rubber and rubber products	**1.2102**	**1.1194**	**1.3610**	**1.4044**
23	Plastic Products	**1.0325**	0.9427	0.9805	**1.1063**
24	Non-metallic mineral products	**1.0862**	**1.1306**	**1.1152**	**1.2078**
25	Basic metal	**1.0892**	0.9720	**1.0499**	**1.0114**
26	Fabricated metal products	**1.0937**	**1.0050**	**1.0818**	**1.0095**
27	Industrial machinery and equipment	0.9620	0.8261	0.9600	0.9050
28	Household machinery and equipment	0.9719	0.8089	0.8073	0.7755
29	Household electric appliance and apparatus	0.9002	0.8608	0.9694	0.7789
30	Precision equipment	0.9698	0.9089	0.8969	0.8566
31	Motor vehicle	0.9516	**1.0217**	**1.0256**	0.9308
32	Other transport equipment	0.9601	**1.0603**	**1.1099**	**1.1830**
33	Other manufacturing products	0.9277	**1.0406**	0.7919	0.8995
34	Electricity, gas, and waterworks	0.9954	0.9267	**1.0989**	0.9021
35	Building and construction	**1.0873**	**1.0953**	**1.0453**	**1.1410**
36	Wholesale and retail trade	0.8994	0.8095	0.8014	0.9071
37	Hotels and restaurants	**1.1684**	**1.1497**	**1.1417**	**1.1606**
38	Transportation services	**1.0150**	**1.0540**	**1.2497**	**1.0934**
39	Postal and telecommunication services	0.8475	0.8400	0.9864	**1.1222**
40	Financial services	0.8884	0.8158	**1.0297**	**1.0643**
41	Real estate and ownership of dwellings	0.7426	0.7849	0.8696	0.9207
42	Business and private services	0.9380	0.8786	0.7836	0.9569
43	Education services	0.7996	0.7914	0.8171	0.7357
44	Healthcare services	0.8901	0.8369	**1.0571**	0.8741
45	Other services	0.9859	0.9550	**1.0576**	0.9433

Table 4.2 presents the Power of Dispersion Index for industries in Malaysia. It is constructed by applying Equation (17) derived in Chapter Three and it is a measure of backward linkage. The backward linkage measures the input directly and indirectly required from other industries for a unit increase in the final demand of an industry's product. The higher the value of backward linkage of an industry, the more dependence the industry has on other industries' input products for its own production.

Referring to Table 4.2, the first column in the table shows the number of industry, the second column shows the name of the industry, and the third column is the Power of Dispersion Index for Backward Linkage for each column of industry for the year 1991, year 2000, year 2005, and year 2010, accordingly. For each year, and for each column of industry, the backward linkage values that are greater than one are bold and highlighted in yellow color. A greater than one backward linkage means that the industry has an above-average dependence on other industries' input products. It also indicates strong backward linkage effect.

Based on the result, it is found that the number of industry having above-average dependence has been increasing over the period of study. From seventeen industries in year 1991, it increased to twenty two in year 2005, to twenty four in year 2005, but fell to twenty two in year 2010. Generally, it shows that there have been more industries playing the role as strong demanders for input from other domestic industries in the economy.

Table 4.1 and Table 4.2 have reported the measures of inter-industrial forward and backward linkage for industries in Malaysia. These measures show that the number of industries having strong backward linkage effect is increasing, while the number of industries having strong forward linkage effect varies across the four time points. The next section will be to apply these measures on the analysis for the change in the structure of production based on the primary, secondary, and tertiary sector, accordingly.

4.2 Structure of Production of the Malaysian Economy

In this section, the structure of production for the Malaysian economy for the period from year 1991 to year 2010 is analyzed by relating the measures of inter-industrial forward and backward linkage to the three broad economic sectors - the primary sector, secondary sector, and tertiary sector. Each sector contains a number of sub-industries. A change in the inter-industrial linkage value may imply a change in the role of a particular industry in the economy at a given time point.

4.2.1 Primary Sector

Figure 4.1: Primary Sector's Sensitivity of Dispersion Index

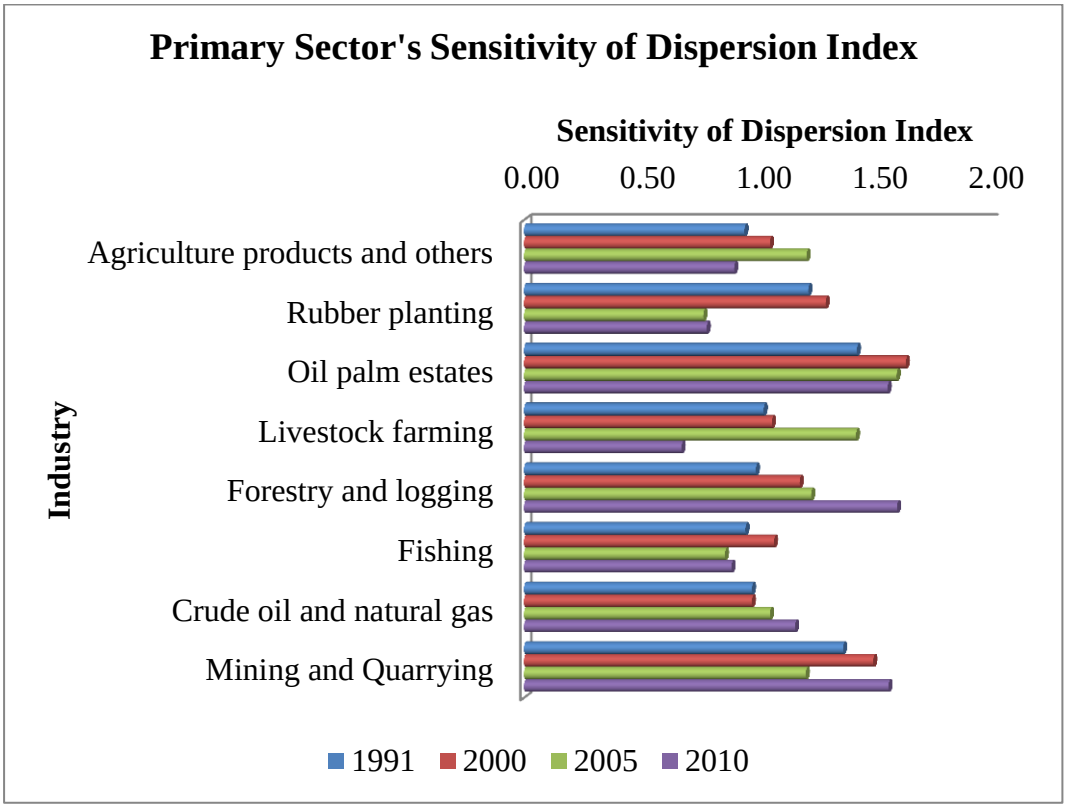
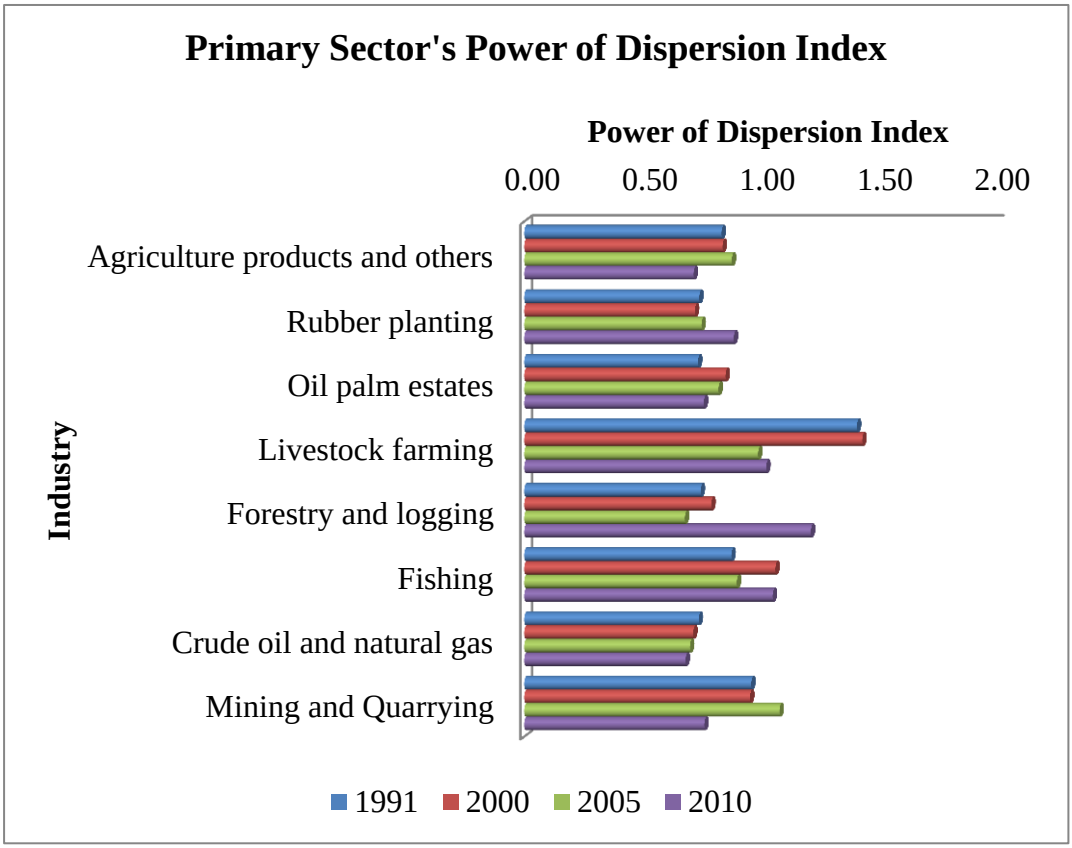


Figure 4.2: Primary Sector's Power of Dispersion Index



Based on Figure 4.1 and Figure 4.2, the primary sector in Malaysia, which includes eight industries in this study, are the agricultural products and others, rubber planting, oil palm estates, livestock farming, forestry and logging, fishing, crude oil and natural gas, and mining and quarrying. Of which, the former six industries are agricultural sub-industries, while the latter two are mining sub-industries.

Based on Figure 4.1, most of the primary sub-industries have shown high forward linkage values, though not consistent, during the period under study. The high forward linkage value is also meant strong forward linkage effect. It indicates that the outputs from these industries are essentially inputs for other domestic industries in the economy. The secondary industries that closely link to the primary industries are those resource-intensive industries producing food-related, wood-related, rubber-related, and mineral-related products (Ismail, 2007).

However, the overall backward linkage values of these industries are low (See Figure 4.2), meaning that they have weak backward linkage effect. This result is not surprise given the fact that the inputs for these industries are, primarily, natural resources. That is, inputs that do not supply by other domestic industries. One exceptional case is the livestock farming. The high backward linkage value of the livestock farming industry is mainly due to its heavy dependence on inputs from domestic industries, such as animal feeds and related inputs from the same industries (Loh, n.d.).

Besides, from Figure 4.1, significant decrease in the forward linkage are found in the livestock farming industry, from 1.4247 in year 2005 to 0.6763 in year 2010. Also, upward trends are observed in the value of forward linkage for forestry and logging industry and crude oil and natural gas industry. This implies that these industries have been increasingly playing the role as suppliers of inputs for other domestic industries in the economy. However, the downward trends are detected in the forward linkage values of the rubber planting industry and the fishing industry, implying their decreasing role as suppliers of inputs to the domestic industries.

Although there was a steady decrease in the share of primary sector's output to overall output during the period 1991-2000, the primary industries remain essentially to be the important suppliers of inputs and raw materials to the economy. This is proven by the strong forward linkages in most of these industries.

4.2.2 Secondary Sector

Figure 4.3: Secondary Sector's Sensitivity of Dispersion Index

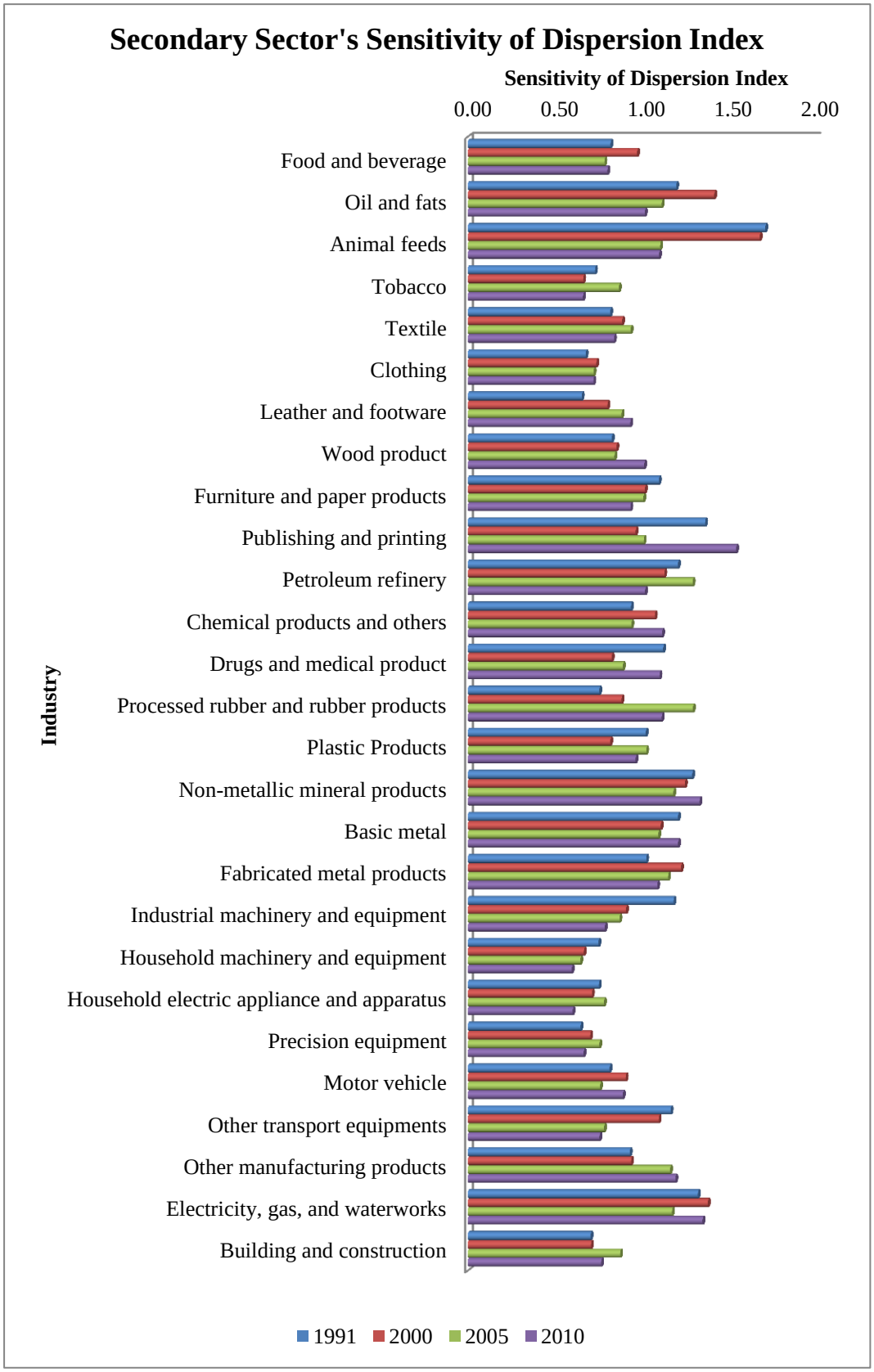
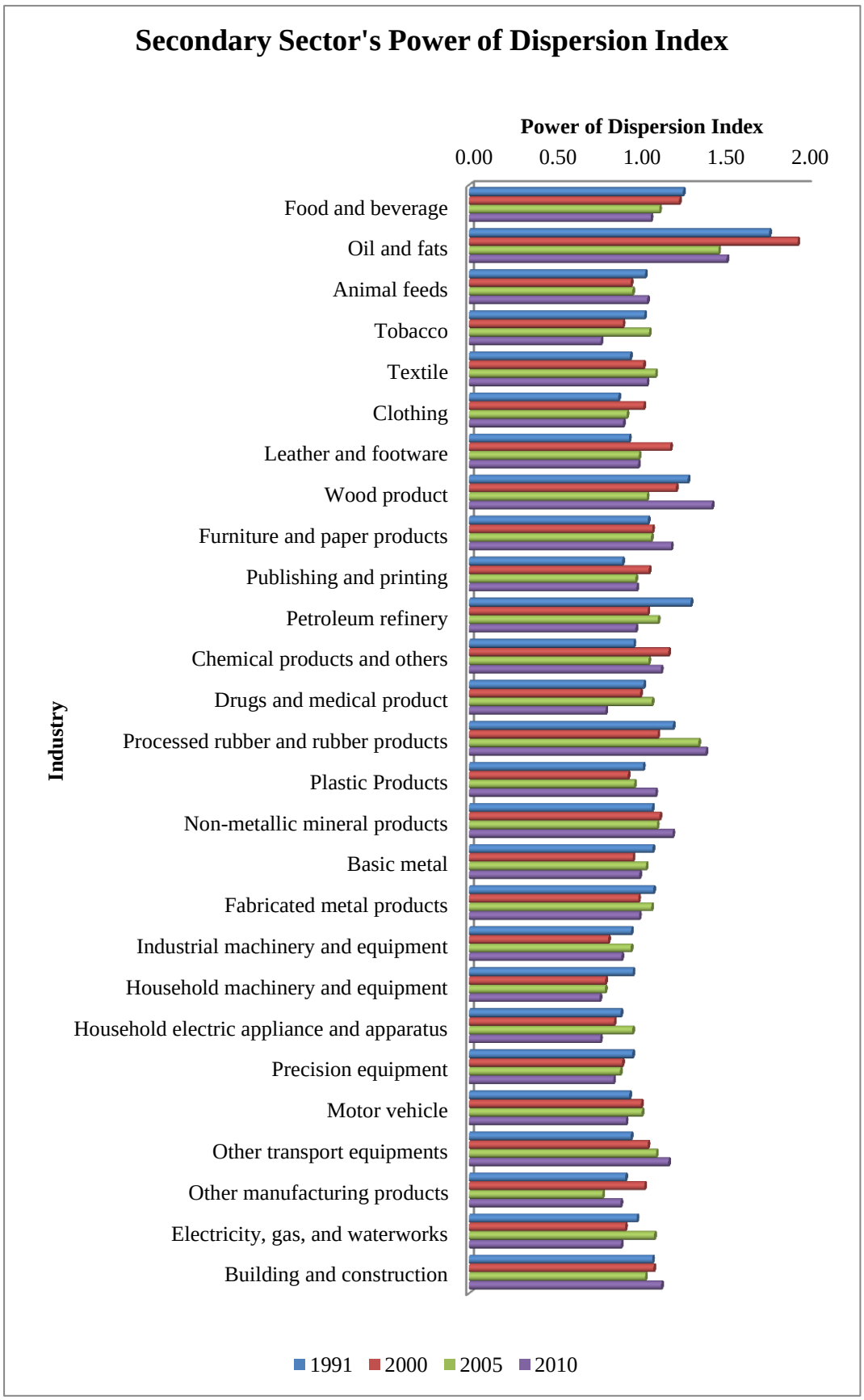


Figure 4.4: Secondary Sector's Power of Dispersion Index



In a broader measure, the Malaysian secondary sector can be break down into the manufacturing sector, the electricity, gas and water sector, and the building and construction sector (Malaysia Input-Output Table, 2010, 2014). Based on Figure 4.3 and Figure 4.4, the former twenty five industries are the manufacturing sub-industries, while the remaining two are the electricity, gas and water industries, and the construction industries, respectively.

By referring to Figure 4.3, the manufacturing sub-industries mainly producing final goods include the food and beverage production, oil and fats, animal feeds, tobacco, textile, leather and footwear, and wood product industry. Generally, these industries have shown weak forward linkage value because their products are mainly for final demand purpose, instead of for further domestic value-added. There are two exceptional cases, which are the oil and fats industry and animal feeds industries, they have shown consistently strong forward linkage effect over the period of study. Turn to backward linkage effect, Figure 4.4 shows that industries under the same group have shown consistently high backward linkage values during the same period. The result is reasonable given the fact that most of these industries are resource-intensive and labor-intensive industries, in which their productions heavily rely on other domestic industries' inputs product, especially on the primary sub-industries. However, the clothing industry is found to have a low backward linkage value. Overall, the structure of production of the resource-intensive and labor-intensive industries remains largely the same over the period of study.

On the other hand, the manufacturing sub-industries producing products for intermediate or industrial use include the furniture and paper products, publishing and printing, petroleum refinery, chemical products and others, drugs and medical products, processed rubber and rubber products, plastic products, non-metallic mineral products, basic metal, and fabricated metal products. Based on Figure 4.3 and Figure 4.4, almost all of these industries have shown strong linkage effects in terms of both forward and backward case. This implies that this group of industries not only play important role as suppliers of inputs, but also demanders for output from other industries in the economy. Based on the result, the forward linkage values for these industries have shown more fluctuating position. Of which, the forward linkage value for the chemical products and others,

drugs and medical products, processed rubber and rubber products, and plastic products industry yielded more fluctuation during the period. On the contrary, the backward linkage values of these industries are quite consistent and strong, either above one or very close to one. Overall, without significant changes, this group of industries has maintained a strong influence and dependence on the production of domestic industries over the period of study.

In addition, there are four industries classified under the machinery sub-industry, they are the industrial machinery and equipment, household machinery and equipment, household electric appliance and apparatus, and the precision equipment industry. Based on Figure 4.3 and Figure 4.4, the machinery sub-industries have shown low value in both forward and backward linkage. Moreover, both linkages values have been decreasing from time to time. The weak forward linkage effect is surprising given the fact that the machinery industries play a crucial role as the supporting industries to the country's overall industrial development, because of its extensive economic linkages to major economic sectors (Department of Skills Development Ministry of Human Resources Malaysia, 2008). The low backward linkage value may indicate that the machinery industries fail to link up with the domestic supply chain, due to their heavy dependence on the imported inputs in support of domestic electrical and electronic related industries (Department of Skills Development Ministry of Human Resources Malaysia, 2008).

Next, for the motor vehicle, other transport equipment, and other manufacturing products industry, the result shows that the forward linkage value of motor vehicle industry is low, while the other two industries have shown more fluctuating position. Instead, the backward linkage value of motor vehicle and other transport equipment industry are strong, but the other manufacturing products industry has shown low backward linkage value. In addition, the electricity, gas, and waterworks industries have shown a low but close-to-one backward linkage. It has strong and consistent forward linkage. This indicates that the industries are key suppliers of inputs and thus mostly provides inputs to other industries although the industries probably still involve some downstream operations. Take electricity as an example. Almost every industry needed electricity to run. Therefore, the electricity industry acted as a supplier to supply

electricity to other industries. The same goes to waterworks. Many industries need water to run as well. Lastly, the building and construction industry have shown consistent strong backward linkage value but low forward linkage value over the period of study. This means that the industry requires substantial amounts of raw materials, such as cement, sand, and steel from other upstream industries, with houses and buildings as finished products. Therefore, it should be considered as a demander of inputs.

4.2.3 Tertiary Sector

Figure 4.5: Tertiary Sector's Sensitivity of Dispersion Index

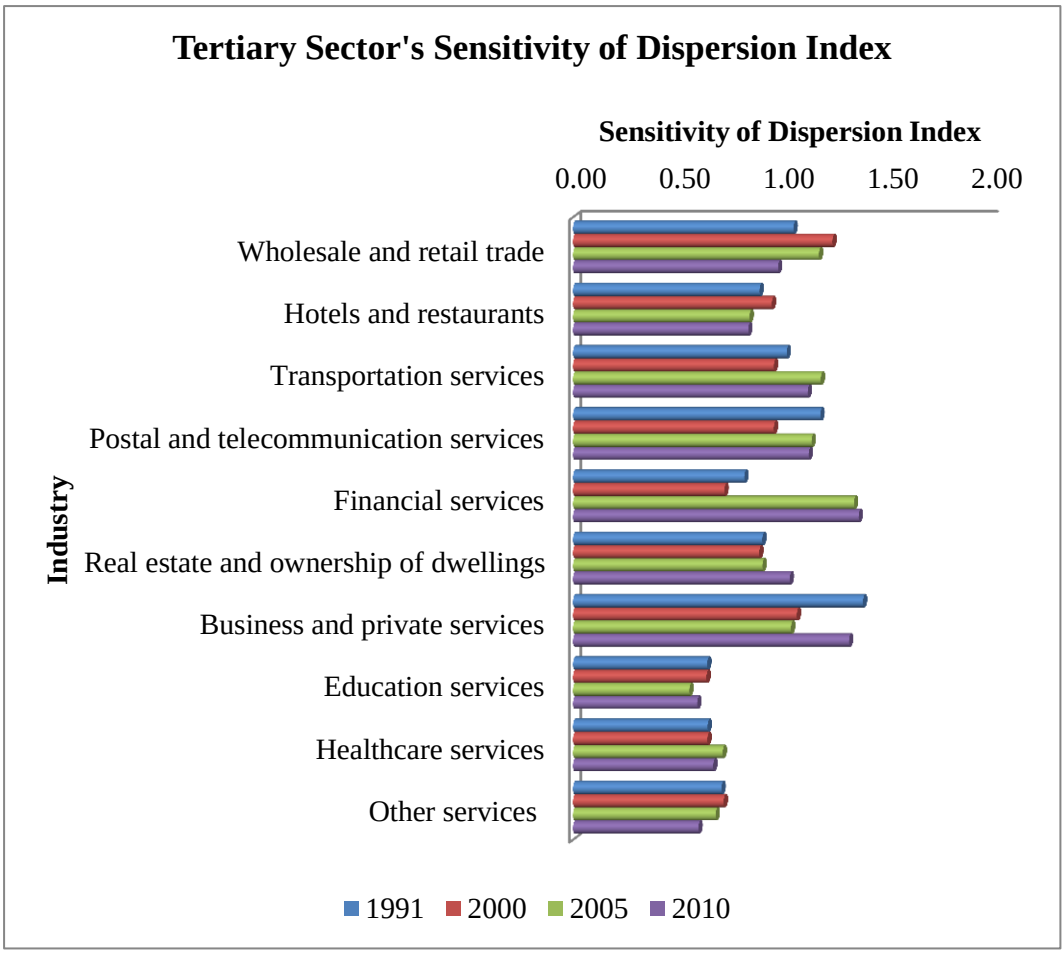
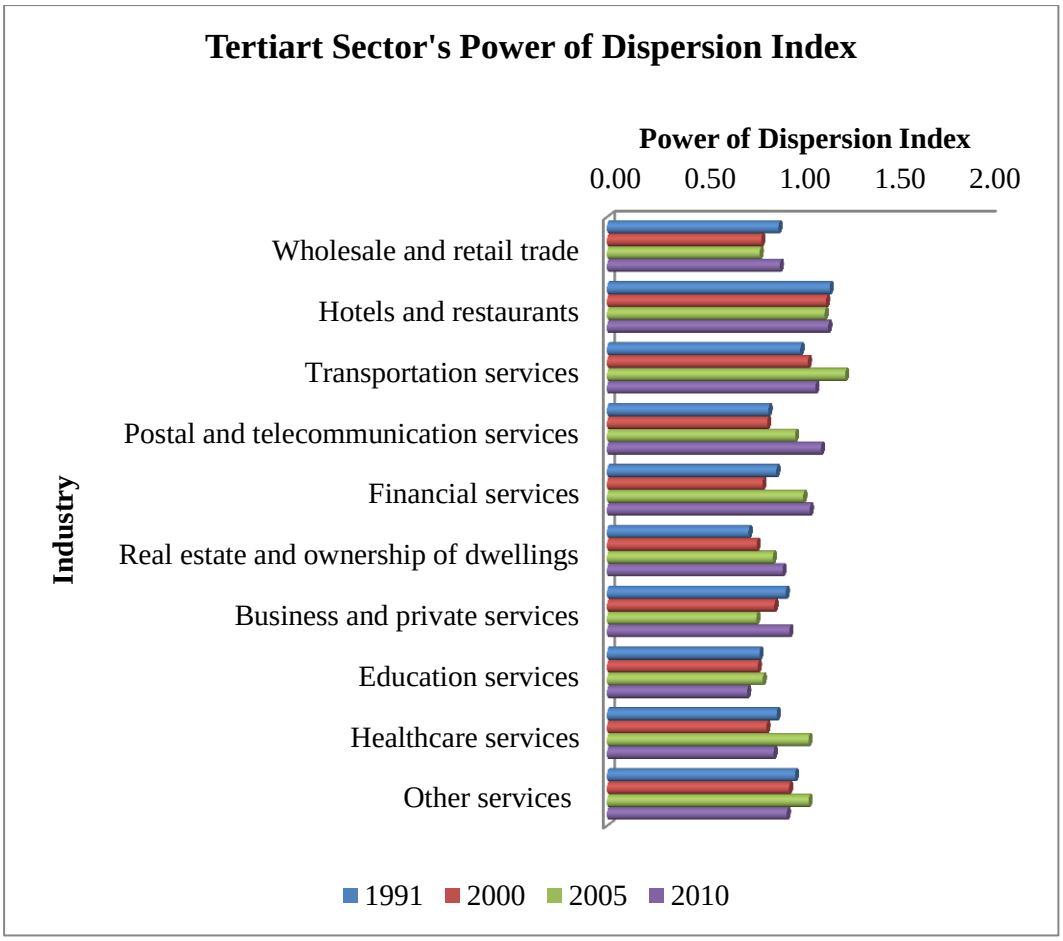


Figure 4.6: Tertiary Sector's Power of Dispersion Linkage



In this study, the Malaysian tertiary sector consists of ten service-based industries. Based on Figure 4.5 and Figure 4.6, it shows that the overall linkage effects of some of the ten tertiary sub-industries are strong over the period of study. Of which, the linkages of the transport services industry can be considered the strongest among the ten tertiary sub-industries, as indicated by its high backward and forward linkage values throughout the period. This suggests that the transport services industry's demand for raw materials, such as fuel, steel, plastic, rubber, maintenance services, and sales of vehicle parts, from other domestic industries are strong. As for the high forward linkages, it could be due to the reason that many sectors need transportation services to have their products distributed. In other words, changes in the industry's linkage effect could bring substantial effects to other industries, both upstream and downstream.

Tertiary sub-industry with moderate backward and forward linkages are postal and telecommunication services, and financial services. The linkages of the sub-industries became strong after year 2005. This could be due to the impact of government policy that putting more emphasis on developing these sub-industries. In addition, the tertiary industries with weak backward linkages are wholesale and retail trade, real estate and ownership of dwellings, and business and private services. This could be due to the nature of their businesses as their businesses involve sales of products to final users, mostly. The forward linkages of the wholesale and retail trade sub-sector are had been strong but turn weak in 2010. The opposite situation happened on the real estate and dwellings sub-sector where the forward linkages had been weak but turned strong in 2010.

The tertiary sub-industry with both weak backward and forward linkages for all the four years is education services. That is to say, the sub-sector has small influence on the rest of the economy. That is surprising since education is important for every country while the education services industry in Malaysia brought small effects to the economy. The linkages of healthcare services, and other services were weak as well, with only strong backward linkages in 2005. One explanation for the weak linkages of the healthcare services sub-industry was that the sub-sector provided services mainly for patients.

Overall, the tertiary sub-industries act as a moderate demander and supplier of the economy. As some of the tertiary sub-industries' linkages have become stronger in the recent years, the tertiary sector will play increasingly important roles in the economy.

4.3 Identification of the 'Key' Industries

One of the objectives of measuring the inter-industrial forward and backward linkage is that they can be used to identify the 'key' industries which are crucial for economic planning. In this study, there are two criterions which are used to identify the 'key' industries. The first criterion is in terms of both the forward linkage and backward linkage greater than one. When backward linkage is greater than one, the industry has an above average dependence on the industries from which it purchases inputs. In the opposite, when forward linkage is greater than one, increases in the demand for regional outputs will have an above stimulus effect on the industry's production. The second criterion is in terms of the relatively low coefficient of variation for both linkages. Industries with low coefficient of variations have influence on other industries' production in a more even manner.

In order to show the importance of each industry in the economy, the forty five industries under this study are ranked based on the values of their backward linkage and forward linkage. The results are shown in Table 4.3 and Table 4.4, respectively. The coefficient of variations for the backward linkage and forward linkage for each industry are also calculated and ranked. The results are presented in Table 4.5 and Table 4.6, respectively. For interpretation, each year's industries with forward or backward linkage value greater one are summarized and presented in tables. The result for each year will be discussed accordingly.

Table 4.3: The Ranking of Power of Dispersion Index of Backward Linkage

Industry	1991		2000		2005		2010	
	U_j	Rank	U_j	Rank	U_j	Rank	U_j	Rank
1	0.8375	39	0.8420	34	0.8810	35	0.7191	44
2	0.7429	42	0.7243	44	0.7525	43	0.8895	34
3	0.7376	45	0.8544	33	0.8248	37	0.7625	42
4	1.4117	2	1.4346	2	0.9925	25	1.0272	19
5	0.7492	41	0.7942	41	0.6820	45	1.2166	4
6	0.8793	37	1.0661	13	0.9024	33	1.0546	18
7	0.7403	44	0.7173	45	0.7034	44	0.6850	45
8	0.9636	23	0.9583	25	1.0834	12	0.7645	41
9	1.2701	5	1.2470	3	1.1293	5	1.0785	14
10	1.7806	1	1.9489	1	1.4791	1	1.5283	1
11	1.0451	13	0.9600	24	0.9699	29	1.0574	16
12	1.0406	14	0.9126	29	1.0684	15	0.7823	38
13	0.9555	26	1.0342	19	1.1056	9	1.0552	17
14	0.8869	36	1.0357	18	0.9360	32	0.9145	29
15	0.9495	28	1.1941	5	1.0078	24	1.0034	22
16	1.2980	4	1.2281	4	1.0554	19	1.4404	2
17	1.0614	12	1.0876	11	1.0803	14	1.1985	6
18	0.9099	31	1.0670	12	0.9881	26	0.9942	23
19	1.3149	3	1.0595	15	1.1205	6	0.9890	24
20	0.9768	20	1.1830	6	1.0652	16	1.1388	10
21	1.0359	15	1.0164	21	1.0846	11	0.8102	37
22	1.2102	6	1.1194	9	1.3610	2	1.4044	3
23	1.0325	16	0.9427	27	0.9805	28	1.1063	12
24	1.0862	11	1.1306	8	1.1152	7	1.2078	5
25	1.0892	9	0.9720	23	1.0499	20	1.0114	20
26	1.0937	8	1.0050	22	1.0818	13	1.0095	21
27	0.9620	24	0.8261	37	0.9600	31	0.9050	31
28	0.9719	21	0.8089	40	0.8073	39	0.7755	40
29	0.9002	32	0.8608	32	0.9694	30	0.7789	39
30	0.9698	22	0.9089	30	0.8969	34	0.8566	36
31	0.9516	27	1.0217	20	1.0256	23	0.9308	27
32	0.9601	25	1.0603	14	1.1099	8	1.1830	7
33	0.9277	30	1.0406	17	0.7919	41	0.8995	33
34	0.9954	18	0.9267	28	1.0989	10	0.9021	32
35	1.0873	10	1.0953	10	1.0453	21	1.1410	9
36	0.8994	33	0.8095	39	0.8014	40	0.9071	30
37	1.1684	7	1.1497	7	1.1417	4	1.1606	8
38	1.0150	17	1.0540	16	1.2497	3	1.0934	13
39	0.8475	38	0.8400	35	0.9864	27	1.1222	11
40	0.8884	35	0.8158	38	1.0297	22	1.0643	15
41	0.7426	43	0.7849	43	0.8696	36	0.9207	28
42	0.9380	29	0.8786	31	0.7836	42	0.9569	25
43	0.7996	40	0.7914	42	0.8171	38	0.7357	43
44	0.8901	34	0.8369	36	1.0571	18	0.8741	35
45	0.9859	19	0.9550	26	1.0576	17	0.9433	26

Note: U_j - Backward Linkage (Power of Dispersion Index)

Refers Table 3.2 for Name of Industry

Table 4.4: The Ranking of Sensitivity of Dispersion Index of Forward Linkage

Industry	1991		2000		2005		2010	
	U_i	Rank	U_i	Rank	U_i	Rank	U_i	Rank
1	0.9461	25	1.0552	18	1.2124	7	0.9019	27
2	1.2197	8	1.2943	6	0.7696	38	0.7843	34
3	1.4286	2	1.6386	2	1.5990	1	1.5605	3
4	1.0285	18	1.0635	17	1.4247	2	0.6763	38
5	0.9952	22	1.1828	10	1.2322	6	1.6007	1
6	0.9504	24	1.0730	16	0.8626	32	0.8905	29
7	0.9784	23	0.9781	20	1.0554	19	1.1630	11
8	1.3689	4	1.4988	3	1.2094	8	1.5639	2
9	0.8221	31	0.9749	21	0.7870	35	0.8043	32
10	1.2001	11	1.4193	4	1.1165	16	1.0192	21
11	1.7122	1	1.6805	1	1.1076	17	1.1012	17
12	0.7326	38	0.6647	43	0.8700	31	0.6635	41
13	0.8203	33	0.8890	30	0.9379	25	0.8420	30
14	0.6792	41	0.7407	36	0.7246	41	0.7235	37
15	0.6563	42	0.8045	35	0.8856	28	0.9356	26
16	0.8297	30	0.8560	32	0.8447	34	1.0159	22
17	1.1001	16	1.0196	19	1.0109	23	0.9365	25
18	1.3662	5	0.9666	22	1.0130	22	1.5447	4
19	1.2099	10	1.1315	11	1.2945	5	1.0208	20
20	0.9398	26	1.0768	14	0.9421	24	1.1187	14
21	1.1250	15	0.8290	33	0.8929	27	1.1038	16
22	0.7575	35	0.8856	31	1.2960	4	1.1166	15
23	1.0247	21	0.8205	34	1.0272	21	0.9661	24
24	1.2922	7	1.2497	7	1.1837	10	1.3343	7
25	1.2104	9	1.1110	12	1.0969	18	1.2108	9
26	1.0273	19	1.2275	9	1.1532	14	1.0911	18
27	1.1848	13	0.9111	27	0.8736	30	0.7891	33
28	0.7524	37	0.6684	42	0.6482	44	0.5991	44
29	0.7548	36	0.7150	39	0.7842	37	0.6040	42
30	0.6496	43	0.7050	41	0.7577	40	0.6671	40
31	0.8170	34	0.9092	28	0.7619	39	0.8927	28
32	1.1678	14	1.0991	13	0.7848	36	0.7586	36
33	0.9328	27	0.9404	26	1.1646	13	1.1954	10
34	1.3246	6	1.3821	5	1.1755	12	1.3514	6
35	0.7073	40	0.7096	40	0.8773	29	0.7683	35
36	1.0580	17	1.2448	8	1.1797	11	0.9837	23
37	0.8949	29	0.9540	25	0.8470	33	0.8404	31
38	1.0249	20	0.9637	23	1.1888	9	1.1258	13
39	1.1869	12	0.9635	24	1.1444	15	1.1304	12
40	0.8217	32	0.7265	37	1.3475	3	1.3703	5
41	0.9081	28	0.8935	29	0.9088	26	1.0398	19
42	1.3911	3	1.0739	15	1.0459	20	1.3240	8
43	0.6440	45	0.6404	45	0.5581	45	0.5957	45
44	0.6456	44	0.6449	44	0.7182	42	0.6728	39
45	0.7125	39	0.7230	38	0.6841	43	0.6016	43

Note: U_i - Forward Linkage (Sensitivity of Dispersion Index)
Refers Table 3.2 for Name of Industry

Table 4.5: The Ranking of Coefficient of Variation of Backward Linkage

Industry	1991		2000		2005		2010	
	V_j	Rank	V_j	Rank	V_j	Rank	V_j	Rank
1	0.9031	15	0.9089	6	0.8253	9	0.8220	13
2	0.9420	10	0.9058	7	0.7129	29	0.6951	27
3	0.9460	9	0.7715	31	0.7895	12	0.7689	16
4	0.8762	25	0.8584	12	0.7366	24	0.6027	39
5	0.9393	11	0.8731	11	0.7851	14	0.9987	3
6	0.8871	21	0.7687	32	0.9442	4	0.6516	36
7	0.9570	5	0.9422	5	0.8014	11	0.8818	5
8	0.8420	35	0.7035	38	0.5153	45	0.7588	18
9	0.7906	43	0.6990	39	0.7226	26	0.7534	20
10	1.1416	1	1.3929	1	1.0365	3	0.9258	4
11	0.8060	42	0.7939	25	0.5653	42	0.5609	45
12	0.8684	27	0.7970	23	0.7145	28	0.7342	23
13	0.9582	4	0.7800	29	0.7674	19	0.6550	35
14	0.9017	16	0.7463	35	0.5937	40	0.6682	33
15	0.8411	36	0.5785	45	0.5780	41	0.6876	28
16	0.8531	31	0.7078	37	0.6746	34	0.6381	37
17	0.8663	28	0.7683	33	0.8537	6	0.5913	42
18	0.8766	24	0.6791	41	0.7705	18	0.6009	40
19	0.9012	17	0.8005	21	0.7291	25	0.7580	19
20	0.8881	20	0.7720	30	0.6738	35	0.7846	15
21	0.8238	41	0.6552	42	0.5194	44	0.7341	24
22	0.8482	34	0.8515	13	1.2445	1	1.0724	2
23	0.8244	40	0.7596	34	0.7043	30	0.6690	31
24	0.8886	19	0.8110	19	0.6494	38	0.6687	32
25	0.9161	12	0.8833	8	0.7873	13	0.8652	7
26	0.8298	39	0.7849	27	0.7794	16	0.6870	29
27	0.8322	37	0.8344	15	0.6944	32	0.6752	30
28	0.8783	22	0.8396	14	0.7196	27	0.7523	21
29	0.9499	6	0.8757	10	0.8747	5	0.7612	17
30	0.8507	32	0.7871	26	0.7521	21	0.6960	26
31	0.9476	8	0.9578	4	0.6983	31	0.8567	9
32	0.9893	2	0.9847	2	0.6503	37	0.5860	44
33	0.8642	30	0.6875	40	0.7599	20	0.8028	14
34	0.8501	33	0.7960	24	0.7748	17	0.8751	6
35	0.7848	44	0.6125	43	0.5292	43	0.5999	41
36	0.8782	23	0.8236	17	0.7378	23	0.7066	25
37	0.7586	45	0.5996	44	0.7842	15	0.5901	43
38	0.8903	18	0.8005	22	0.8283	8	0.7360	22
39	0.9657	3	0.8180	18	0.6852	33	0.8585	8
40	0.9151	13	0.8804	9	1.1065	2	1.1427	1
41	0.9479	7	0.9682	3	0.7455	22	0.8344	11
42	0.8690	26	0.8045	20	0.8133	10	0.8501	10
43	0.9067	14	0.8246	16	0.6711	36	0.8277	12
44	0.8653	29	0.7809	28	0.8420	7	0.6607	34
45	0.8310	38	0.7453	36	0.6165	39	0.6379	38

Note: V_j - Coefficient of Variation for Backward Linkage

Refers Table 3.2 for Name of Industry

Table 4.6: The Ranking of Coefficient of Variation of Forward Linkage

Industry	1991		2000		2005		2010	
	V_i	Rank	V_i	Rank	V_i	Rank	V_i	Rank
1	0.7059	29	0.7364	32	0.6653	33	0.7128	34
2	0.8430	21	0.8432	20	0.7004	27	0.7818	24
3	1.0225	2	1.0448	2	1.0235	6	1.0171	4
4	0.9325	14	1.0158	6	0.5545	41	0.8534	16
5	0.7452	25	0.6525	41	0.5556	39	0.8408	17
6	0.7190	28	0.7571	31	0.9829	8	0.7691	25
7	0.6768	34	0.7018	36	0.6003	36	0.6492	37
8	0.5981	40	0.6846	38	0.4958	45	0.4929	44
9	0.8989	16	0.8781	19	1.0208	7	1.0099	5
10	1.6981	1	1.7502	1	1.2280	3	1.1873	2
11	0.9501	13	0.9596	13	0.5103	44	0.7867	22
12	1.0016	4	1.0440	3	0.8631	17	0.8681	14
13	1.0032	3	0.8815	18	0.8938	13	0.8068	20
14	0.9905	7	0.9924	8	0.7430	23	0.8353	18
15	0.9619	11	0.8245	25	0.6993	28	0.7352	31
16	0.8981	17	0.8254	24	0.7842	20	0.7440	27
17	0.6750	35	0.7829	29	0.9007	12	0.7363	30
18	0.4966	44	0.7101	35	0.7361	25	0.4658	45
19	0.5780	41	0.6424	42	0.5546	40	0.5896	42
20	0.7587	24	0.8061	27	0.7367	24	0.7833	23
21	0.6565	36	0.7896	28	0.6871	30	0.6698	36
22	0.9632	10	1.0215	5	1.2822	1	1.3346	1
23	0.6319	37	0.8331	22	0.6792	31	0.7365	29
24	0.7991	22	0.8304	23	0.6630	34	0.7264	32
25	0.7427	26	0.7689	30	0.7528	21	0.7428	28
26	0.6810	33	0.6606	40	0.7169	26	0.6195	39
27	0.5132	42	0.7280	33	0.7515	22	0.7624	26
28	0.9229	15	0.9712	12	0.8721	16	0.9752	8
29	1.0010	5	1.0128	7	1.0679	4	0.9834	7
30	1.0006	6	0.9774	11	0.8832	14	0.8952	10
31	0.9772	8	1.0333	4	0.9270	11	0.8993	9
32	0.7674	23	0.9219	16	0.8822	15	0.8944	11
33	0.6835	32	0.7203	34	0.5421	42	0.6075	41
34	0.5050	43	0.5049	45	0.6719	32	0.5726	43
35	0.8840	19	0.9022	17	0.6301	35	0.8700	13
36	0.6144	39	0.5337	44	0.5190	43	0.6489	38
37	0.6951	30	0.6881	37	1.0294	5	0.7868	21
38	0.7329	27	0.8349	21	0.8327	19	0.6952	35
39	0.6247	38	0.6806	39	0.5681	38	0.8246	19
40	0.8444	20	0.9485	15	0.8344	18	0.8768	12
41	0.6864	31	0.8136	26	0.6965	29	0.7232	33
42	0.4762	45	0.6272	43	0.5966	37	0.6151	40
43	0.9578	12	0.9840	9	0.9745	9	1.0238	3
44	0.9712	9	0.9796	10	1.2339	2	0.8570	15
45	0.8967	18	0.9528	14	0.9388	10	1.0031	6

Note: V_i - Coefficient of Variation for Forward Linkage

Refers Table 3.2 for Name of Industry

Key industries in Year 1991

Table 4.7: Year 1991 industries with $U_j > 1$

Rank	Industry	U_j	V_j
1	Oil and fats	1.7806	1.1416
2	Livestock farming	1.4117	0.8762
3	Petroleum refinery	1.3149	0.9012
4	Wood product	1.2980	0.8531
5	Food and beverage	1.2701	0.7906
6	Processed rubber and rubber products	1.2102	0.8482
7	Hotels and restaurants	1.1684	0.7586
8	Fabricated metal products	1.0937	0.8298
9	Basic metal	1.0892	0.9161
10	Building and construction	1.0873	0.7848
11	Non-metallic mineral products	1.0862	0.8886
12	Furniture and paper products	1.0614	0.8663
13	Animal feeds	1.0451	0.8060
14	Tobacco	1.0406	0.8684
15	Drugs and medical product	1.0359	0.8238
16	Plastic Products	1.0325	0.8244
17	Transportation services	1.0150	0.8903

Note: U_j – Backward Linkage V_j – Coefficient of Variation of Backward Linkage

Table 4.8: Year 1991 industries with $U_i > 1$

Rank	Industry	U_i	V_i
1	Animal feeds	1.7122	0.9501
2	Oil palm estates	1.4286	1.0225
3	Business and private services	1.3911	0.4762
4	Mining and Quarrying	1.3689	0.5981
5	Publishing and printing	1.3662	0.4966
6	Electricity, gas, and waterworks	1.3246	0.5050
7	Non-metallic mineral products	1.2922	0.7991
8	Rubber planting	1.2197	0.8430
9	Basic metal	1.2104	0.7427
10	Petroleum refinery	1.2099	0.5780
11	Oil and fats	1.2001	1.6981
12	Postal and telecommunication services	1.1869	0.6247
13	Industrial machinery and equipment	1.1848	0.5132
14	Other transport equipment	1.1678	0.7674
15	Drugs and medical product	1.1250	0.6565
16	Furniture and paper products	1.1001	0.6750
17	Wholesale and retail trade	1.0580	0.6144
18	Livestock farming	1.0285	0.9325
19	Fabricated metal products	1.0273	0.6810
20	Transportation services	1.0249	0.7329
21	Plastic Products	1.0247	0.6319

Note: U_i – Forward Linkage V_i – Coefficient of Variation of Forward Linkage

Table 4.7 and Table 4.8 present the results for the year 1991. Table 4.7 shows the industries with backward linkage values greater than one and their associated coefficient of variation for the year 1991. The order of the industries is based on the ranking of the backward linkage value. Table 4.8 reports the forward linkages and has the same definition as Table 4.7.

Based on Table 4.7, there are seventeen industries that have backward linkages value greater than one. Oil and fats, livestock farming, and petroleum refinery are the top three industries with the highest backward linkage value, followed by wood product, food and beverage, processed rubber and rubber products and so on. For forward linkage, Table 4.8 shows that there are twenty one industries that have forward linkage value greater than one. Animal feeds, oil palm estates, and business and private services rank the top three industries in term of the forward linkage, followed by mining and quarrying, publishing and printing, electricity, gas and waterworks, and so on.

Based on the first criterion for the identification of the 'key' industry, for the year 1991, eleven industries are identified as the key industries. These industries are oil and fats, livestock farming, petroleum refinery, fabricated metal products, basic metal, non-metallic mineral products, furniture and paper products, animal feeds, drugs and medical products, plastic products, and transportation services. Of which, livestock farming is the industry from primary sector. Industries from the tertiary sector are the hotel and restaurant industry and the transport services industry. The remaining fourteen industries are from the secondary sectors.

On the other hand, the inferences are robust based on the second criterion and by referring Bekhet's (2010) interpretation, where the values of coefficient of variation for both forward and backward linkages for the key industries are considered low.

Key Industries in Year 2000

Table 4.9: Year 2000 industries with $U_j > 1$

Rank	Industry	U_j	V_j
1	Oil and fats	1.9489	1.3929
2	Livestock farming	1.4346	0.8584
3	Food and beverage	1.2470	0.6990
4	Wood product	1.2281	0.7078
5	Leather and footwear	1.1941	0.5785
6	Chemical products and others	1.1830	0.7720
7	Hotels and restaurants	1.1497	0.5996
8	Non-metallic mineral products	1.1306	0.8110
9	Processed rubber and rubber products	1.1194	0.8515
10	Building and construction	1.0953	0.6125
11	Furniture and paper products	1.0876	0.7683
12	Publishing and printing	1.0670	0.6791
13	Fishing	1.0661	0.7687
14	Other transport equipment	1.0603	0.9847
15	Petroleum refinery	1.0595	0.8005
16	Transportation services	1.0540	0.8005
17	Other manufacturing products	1.0406	0.6875
18	Clothing	1.0357	0.7463
19	Textile	1.0342	0.7800
20	Motor vehicle	1.0217	0.9578
21	Drugs and medical product	1.0164	0.6552
22	Fabricated metal products	1.0050	0.7849

Note: U_j – Backward Linkage V_j – Coefficient of Variation of Backward Linkage

Table 4.10: Year 2000 industries with $U_i > 1$

Rank	Industry	U_i	V_i
1	Animal feeds	1.6805	0.9596
2	Oil palm estates	1.6386	1.0448
3	Mining and Quarrying	1.4988	0.6846
4	Oil and fats	1.4193	1.7502
5	Electricity, gas, and waterworks	1.3821	0.5049
6	Rubber planting	1.2943	0.8432
7	Non-metallic mineral products	1.2497	0.8304
8	Wholesale and retail trade	1.2448	0.5337
9	Fabricated metal products	1.2275	0.6606
10	Forestry and logging	1.1828	0.6525
11	Petroleum refinery	1.1315	0.6424
12	Basic metal	1.1110	0.7689
13	Other transport equipment	1.0991	0.9219
14	Chemical products and others	1.0768	0.8061
15	Business and private services	1.0739	0.6272
16	Fishing	1.0730	0.7571
17	Livestock farming	1.0635	1.0158
18	Agriculture products and others	1.0552	0.7364
19	Furniture and paper products	1.0196	0.7829

Note: U_i – Forward Linkage V_i – Coefficient of Variation of Forward Linkage

Table 4.9 and Table 4.10 present the inter-industrial backward and forward linkage for the year 2000, respectively. Moving on to the year 2000, there are twenty two industries have backward linkage value greater than one (as shown in Table 4.9), compared to seventeen industries in the year 1991. Of which, oil and fats and livestock farming remain to be the top two industries with the highest backward linkage value. Food and beverage has replaced petroleum refinery (rank No.15) to become the industry with the third highest backward linkage value. The industries followed by are wood product, leather and footwear, chemical products and others, and so on. In respect of forward linkage value, there are nineteen industries record a greater than one forward linkage value (as shown in Table 4.10), compared to twenty one industries in the year 1991. Animal feeds and oil palm estates remain to be the first and the second industry in terms of the highest forward linkage value. The mining and quarrying, which was ranked No. 4 in year 1991, has replaced business and private services (rank No. 15) to become the industry with the third highest forward linkage values. The following industries are oil and fats, electricity, gas and waterworks, rubber planting, and so on.

For year 2000, there are only eight industries identified as ‘key’ industry. These industries are oil and fats, fabricated metal products, petroleum refinery, other transport equipment, chemical products and others, fishing, livestock farming, and furniture and paper products. From year 1991 to 2000, livestock farming, fabricated metal products, petroleum refinery, and furniture and paper products are the four industries remain as the key industry in the economy. Out of the eight industries, fishing, and livestock farming are the industries from the primary sector and the remaining six industries are from the secondary sector. None of the eight key industries is from the tertiary sector. Similarly, the key industries inferences for year 2000 are robust as well based on the second criterion, because the values of coefficient of variation for both forward and backward linkages for the key industries are low.

Key Industries in Year 2005

Table 4.11: Year 2005 industries with $U_j > 1$

Rank	Industry	U_j	V_j
1	Oil and fats	1.4791	1.0365
2	Processed rubber and rubber products	1.3610	1.2445
3	Transportation services	1.2497	0.8283
4	Hotels and restaurants	1.1417	0.7842
5	Food and beverage	1.1293	0.7226
6	Petroleum refinery	1.1205	0.7291
7	Non-metallic mineral products	1.1152	0.6494
8	Other transport equipment	1.1099	0.6503
9	Textile	1.1056	0.7674
10	Electricity, gas, and waterworks	1.0989	0.7748
11	Drugs and medical product	1.0846	0.5194
12	Mining and Quarrying	1.0834	0.5153
13	Fabricated metal products	1.0818	0.7794
14	Furniture and paper products	1.0803	0.8537
15	Tobacco	1.0684	0.7145
16	Chemical products and others	1.0652	0.6738
17	Other services	1.0576	0.6165
18	Healthcare services	1.0571	0.8420
19	Wood product	1.0554	0.6746
20	Basic metal	1.0499	0.7873
21	Building and construction	1.0453	0.5292
22	Financial services	1.0297	1.1065
23	Motor vehicle	1.0256	0.6983
24	Leather and footwear	1.0078	0.5780

Note: U_j – Backward Linkage V_j – Coefficient of Variation of Backward Linkage

Table 4.12: Year 2005 industries with $U_i > 1$

Rank	Industry	U_i	V_i
1	Oil palm estates	1.5990	1.0235
2	Livestock farming	1.4247	0.5545
3	Financial services	1.3475	0.8344
4	Processed rubber and rubber products	1.2960	1.2822
5	Petroleum refinery	1.2945	0.5546
6	Forestry and logging	1.2322	0.5556
7	Agriculture products and others	1.2124	0.6653
8	Mining and Quarrying	1.2094	0.4958
9	Transportation services	1.1888	0.8327
10	Non-metallic mineral products	1.1837	0.6630
11	Wholesale and retail trade	1.1797	0.5190
12	Electricity, gas, and waterworks	1.1755	0.6719
13	Other manufacturing products	1.1646	0.5421
14	Fabricated metal products	1.1532	0.7169
15	Postal and telecommunication services	1.1444	0.5681
16	Oil and fats	1.1165	1.2280
17	Animal feeds	1.1076	0.5103
18	Basic metal	1.0969	0.7528
19	Crude oil and natural gas	1.0554	0.6003
20	Business and private services	1.0459	0.5966
21	Plastic Products	1.0272	0.6792
22	Publishing and printing	1.0130	0.7361
23	Furniture and paper products	1.0109	0.9007

Note: U_i – Forward Linkage V_i – Coefficient of Variation of Forward Linkage

Table 4.11 and Table 4.12 present the inter-industrial backward and forward linkage values for the year 2005, respectively. Based on Table 4.11, there are twenty four industries with backward linkage values greater than one. The oil and fats continue to remain as the top industry with the highest backward linkage value, followed by processed rubber and rubber products, transportation services, hotel and restaurants, food and beverage, petroleum refinery, and so on. For forward linkage, there are twenty three industries have forward linkage values greater than one (as shown in Table 4.12). Compared to year 2000, there is substantial change in the ranking of the forward linkage. The oil palm estate has had the highest forward linkage value, followed by livestock farming. Surprisingly, the financial services industry, which did not appear in the year 1991 and year 2000 results, has ranked the third in terms of the highest forward linkage values in the year 2005. The following industries are processed rubber and rubber products,

petroleum refinery, forestry and logging, agricultural products and others, and so on.

For year 2005, there are eleven industries identified as the key industries. They are oil and fats, processed rubber and rubber products, transport services, petroleum refinery, non-metallic mineral products, electricity, gas, and waterworks, mining and quarrying, fabricated metal products, furniture and paper products, basic metals, and financial services. The key finding for the year 2005 is that none of the key industries is from the primary sector. Almost all of the key industries are from the secondary sectors, except transportation services and financial services which are from the tertiary sector.

Likewise, the key industries inferences based on the first criterion are consistent with the inferences based on the second criterion. That is, all the key industries possessed relatively low coefficient of variation for both forward and backward linkages.

Key Industries in Year 2010

Table 4.13: Year 2010 industries with $U_j > 1$

Rank	Industry	U_j	V_j
1	Oil and fats	1.5283	0.9258
2	Wood product	1.4404	0.6381
3	Processed rubber and rubber products	1.4044	1.0724
4	Forestry and logging	1.2166	0.9987
5	Non-metallic mineral products	1.2078	0.6687
6	Furniture and paper products	1.1985	0.5913
7	Other transport equipment	1.1830	0.5860
8	Hotels and restaurants	1.1606	0.5901
9	Building and construction	1.1410	0.5999
10	Chemical products and others	1.1388	0.7846
11	Postal and telecommunication services	1.1222	0.8585
12	Plastic Products	1.1063	0.6690
13	Transportation services	1.0934	0.7360
14	Food and beverage	1.0785	0.7534
15	Financial services	1.0643	1.1427
16	Animal feeds	1.0574	0.5609
17	Textile	1.0552	0.6550
18	Fishing	1.0546	0.6516
19	Livestock farming	1.0272	0.6027
20	Basic metal	1.0114	0.8652
21	Fabricated metal products	1.0095	0.6870
22	Leather and footwear	1.0034	0.6876

Note: U_j – Backward Linkage V_j – Coefficient of Variation of Backward Linkage

Table 4.14: Year 2010 industries with $U_i > 1$

Rank	Industry	U_i	V_i
1	Forestry and logging	1.6007	0.8408
2	Mining and Quarrying	1.5639	0.4929
3	Oil palm estates	1.5605	1.0171
4	Publishing and printing	1.5447	0.4658
5	Financial services	1.3703	0.8768
6	Electricity, gas, and waterworks	1.3514	0.5726
7	Non-metallic mineral products	1.3343	0.7264
8	Business services	1.3240	0.6151
9	Basic metal	1.2108	0.7428
10	Other manufacturing products	1.1954	0.6075
11	Crude oil and natural gas	1.1630	0.6492
12	Postal and telecommunication services	1.1304	0.8246
13	Transportation services	1.1258	0.6952
14	Chemical products and others	1.1187	0.7833
15	Processed rubber and rubber products	1.1166	1.3346
16	Drugs and medical product	1.1038	0.6698
17	Animal feeds	1.1012	0.7867
18	Fabricated metal products	1.0911	0.6195
19	Real estate and ownership of dwellings	1.0398	0.7232
20	Petroleum refinery	1.0208	0.5896
21	Oil and fats	1.0192	1.1873
22	Wood product	1.0159	0.7440

Note: U_i – Forward Linkage V_i – Coefficient of Variation of Forward Linkage

The year 2010 is selected as the ending point for this research because the latest input-output table available for analysis is the 2010 Malaysian Input-Output table. The results for the year 2010 inter-industrial backward and forward linkage are presented in Table 4.13 and Table 4.14, respectively. Based on Table 4.13, there are twenty two industries have backward linkage value greater than one. Oil and fats continue to rank as the top with the highest backward linkage value over the period of study. The second and the third highest backward linkage are recorded by the wood products and the processed rubber and rubber products industry. The industries followed by are forestry and logging, non-metallic mineral products, furniture and paper products, and so on. On the other hand, Table 4.14 shows that there are twenty two industries with forward linkage greater than one. Forestry and logging has climbed up from rank No. 6 in year 2005 to the top in terms of the forward linkage in year 2010. The second and the third are

recorded by mining and quarrying and oil palm estates, follow by publishing and printing , financial services, electricity and gas, and so on.

For year 2010, there are twelve industries identified as the key industry. These industries are oil and fats, wood products, processed rubber and rubber products, forestry and logging, non-metallic mineral products, chemical products and others, postal and telecommunication services, transportation services, financial services, animal feeds, basic metal, and fabricated metal products. Out of the twelve key industries, only the forestry and logging industry is from the primary sector. There are three industries from the tertiary sector, which are the postal and telecommunication services, the transportation services, and the financial services industry. The remaining nine industries are from the secondary sector.

As the general rule, the inferences for key industry for year 2010 are robust as well because the values of coefficient of variation for both forward and backward for the key industries are, again, low.

The key industries for the four selected years are summarized in Table 4.15 as below.

Table 4.15: Key Industries for the Malaysian Economy

1991	2000
1. Oil and fats 2. Livestock farming 3. Petroleum refinery 4. Fabricated metal products 5. Basic metal 6. Non-metallic mineral products 7. Furniture and paper products 8. Animal feeds 9. Drugs and medical products 10. Plastic products 11. Transportation services	1. Oil and fats 2. Fabricated metal products 3. Petroleum refinery 4. Other transport equipment 5. Chemical products and others 6. Fishing 7. Livestock farming 8. Furniture and paper products
2005	**2010**
1. Oil and fats 2. Processed rubber and rubber products 3. Transport services 4. Petroleum refinery 5. Non-metallic mineral products 6. Electricity, gas, and waterworks 7. Mining and quarrying 8. Fabricated metal products 9. Furniture and paper products 10. Basic metal 11. financial services	1. Oil and fats 2. Wood products 3. Processed rubber and rubber products 4. Forestry and logging 5. Non-metallic mineral products 6. Chemical products and others 7. Postal and telecommunication services 8. Transportation services 9. Financial services 10. Animal feeds 11. Basic metal 12. Fabricated metal products

4.4 Conclusion

In this chapter, the measures of inter-industrial backward and forward linkages are obtained by applying Equation (17) and Equation (18) derived in Chapter Three, respectively. These measures have been used to analyze the structure of production for the Malaysian economy throughout the year 1991 to year 2010. Furthermore, the key industries in the Malaysian economy for the four time points are identified based on the two criterions, which are both forward and backward linkage greater than one, and the low coefficient of variation for both linkages. In the end of this chapter, the four time point's key industries are summarized in Table 4.15. The empirical results will be used to form policy implications in the next chapter.

CHAPTER 5 CONCLUSION, IMPLICATIONS, AND RECOMMENDATIONS

5.0 Introduction

Chapter Five will conclude the major findings of this research, draw policy implications, discuss limitations and provide recommendations for future research.

5.1 Concluding the Major Findings

The purpose of this research is to examine the structure of production for the Malaysia economy over the period from year 1991 to 2010. By using the I-O analysis, the focus is on whether the implementation of structural and institutional policy reforms during the period of study have caused the inter-industrial forward and backward linkages for the Malaysia's industries to change, so that the structure of production has subsequently shifted. Inter-industrial linkages can affect a country's industrial structure and economic growth. Therefore, a study of the change in the inter-industrial linkages across time is important to evaluate and monitor the progress of economic development. By measuring inter-industrial linkages, it would allow for the identification of the key industries for the Malaysian economy, which are crucial for economic planning.

Generally, our results suggest that with the policy reforms undertaken by planners in Malaysia over the 20 years under study, the structure of production has shown changes, but the changes are not obvious and tend to concentrate on few areas of the economy. The result for the primary sectors shows that the industries under the period of study hold strong forward linkage effect. This means that they act as strong suppliers throughout the whole economy, and many industries depending on these primary sub- industries to supply for their input for production. Besides, due to the fact that the primary sectors mostly involve themselves in the production of raw materials, it is reasonable to say that these industries are still important to other industries in Malaysia.

Moving on to the secondary sector, the research identified that most industries of the secondary sector show both strong forward and backward linkage effect, signaling that these industries occupied important roles in the overall industrial and economic development. The strong evidence can be seen on the manufacturing industries, as they act as strong demander of input and at the same time spread their output widely throughout the economy. However, there are some exceptions such as the machinery sub-industries which show poor industrial linkages to the economy. If the inter-industrial linkages in the machinery industry had been intensified, it would have promoted a deeper economic linkage, and induced a larger production in the overall process of economic development (Hayashi, 2005).

Furthermore, some tertiary industries for the Malaysian economy have shown significant changes during the period of study, gaining stronger linkages from year to year with other industries. The most prominent example include the business and private services and the financial services industry, Over time, they are getting more and more linked with all the sectors throughout the economy. On the other hand, there are other industries in the tertiary sector that shows no change in linkages and remains weak, such as the education industry, which shall be one of the most crucial elements to progress a developing country to a developed country, but yet to show any significant changes in linkages effect.

Overall, the Malaysian economy has transformed from a resource-based economy, to a more value added and manufacturing based economy. Given the scope of time of this research, which is 20 years, the speed of transformation is considerably slow but still has some degree of changes. Key industries varies year by year, but industries like the oil and fats industry stays as the key industry, and the more new tertiary sector industries are gaining their position on the list of key industries for Malaysia.

5.2 Policy Implications

Over the period under study, the Malaysian government has introduced three Industrial Master Plans covering different planning horizons, which are the IMP1 (1986-1995), IMP2 (1996-2005), and IMP3 (2006-2020). The aims for the plans are to strengthen domestic industrial linkages, move towards higher domestic value-added, as well as to achieve deeper economic integration. Therefore, the government has made effort by focusing on the development of certain key areas in the economy so as to accomplish their planned target. Under the IMP1, the government emphasize on the expansion of manufacturing sectors to become the leading growth sector of the economy. Under the IMP2, the main focus has shifted towards promoting the development of services sector, with the objective of further deepening industrial linkages, increasing the level of productivity, as well as improving competitiveness of domestic industries. Under the IMP3, the scope of the plan has been expanded to cover more industries, such as agro-based industries, non-government services sector, and resource-based industries.

However, this research has provided evidence for the policy impact of the three Industrial Master Plans on the overall structure of production for the Malaysian economy. Even though some of the industries did really achieve a certain level of improvement in terms of their linkages effect, the government is still far away from the goal towards deeper economic integration. This is because there are still many industries remain poorly linked with others in the economy. One of the most prominent examples is the machinery industries, which has been greatly emphasized by the government through the heavy industrialization programme in the mid-1980s, but have shown weak linkage effects throughout the 20 years. Another example can be seen from some tertiary sub-industries, such as the education services, healthcare services, and other services industry. In addition, almost all of the resource intensive industries in the manufacturing sector are yet to have any strong forward linkage with other domestic industries, implying weak result towards achieving higher value-added activities in the domestic economy.

The policy implication for this research is that policymakers can determine the impact flowing from the stimulation of a particular industry to other economic

sectors. In the case of Malaysia, the government shall pay attention to the key industries (as listed in Table 4.15), as these industries hold strong linkage with other industries in the economy. By doing so, it provides the government a channel to spread the growth towards the whole economy through utilizing the extensive inter-industrial linkages of the key industries to stimulate growth in other industries. Therefore, the government shall spend more on investments towards the key industries.

In addition, Malaysia is closing up to year 2020, which is a target set by the Malaysian government aiming to transform Malaysia into a developed economy, striving for strong economic growth. Therefore, industries with inter-industrial linkages below or close to one shall be another area the Malaysian planners shall focus on. This is because these industries are under-developed, but are nearly classify as key industries. The government shall strategically carry out development plan that promote the development of these industries, as they have considerable potential to become industries with strong economic influence.

5.3 Limitations and Recommendations for Further Research

This research has performed an analysis on the structure of production for the Malaysian economy for the four selected years, which were year 1991, 2000, 2005 and 2010, through an input-output approach. One limitation of this research is that the unweighted backward linkage and forward linkage were used in the analysis of key industries. The unweighted approach assumes that all industries are to be equally importance in the economy. In reality, no all industries are equally important. Each industry must have their relative importance in terms of output or factor utilization. To get a better inference for the key industry, future research can apply a weighted approach to compare with the result of the unweighted approach. The weighted approach is better than the unweighted approach as it considers the relative importance of the industries in the economy, probably in terms of final demand, primary inputs, exports, and other factors.

Another limitation to be mentioned is the assumptions limited for the I-O model, such as constant return to scales and single commodity produced by each industry, which do not reflect the real world situation of industrial production. In addition, the finding of this paper is also subject to historical data, which only shows the key industries in a given time period, but do these key industries match with the industries promoted by policy makers currently? Further research shall be expanded to this field in order to come out with a better model that is able to identify industries with great potential in the coming future.

Last but not least, there are still many challenges for future research on this topic as rapid changing economy conditions and policies tend to cause the structure of production to change from time to time. The establishment of new industry may affect the refinement of the research, as the measures of inter-industrial linkage are usually based on a list of reclassified industries, which may not show the true estimation for each industry's linkage. Therefore, further research shall use more precise industry classification in order to get more meaningful linkage estimation.

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