DETERMINANTS OF PRODUCTIVITY GROWTH IN THE MALAYSIAN FOOD PROCESSING INDUSTRY

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By

YODFIATFINDA

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfillment of the Requirements for the Degree of Doctor of Philosophy.

April 2012

DEDICATION

I dedicate this thesis to my lovely wife
Dr. Ir. Hanifah Nuryani Lioe, MSi., and to
our children **Muhammad Ihsan Adfinda** and
Fathya Mubina Adfinda.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia
in fulfillment of the requirement for the degree of Doctor of Philosophy

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Chairman : Professor Mad Nasir Shamsudin, PhD

Faculty : Agriculture

Malaysia is a net importer of food products for the last two decades. Value of imported food grew from RM 8.2 billion in 1996 to RM 28 billion in 2008; spawning a larger trade deficit of RM 10.1 billion compared to RM 4.2 billion in 1996 (MIDA, 2010). Demand for processed food in Malaysia is on the rise. The increasing trend is likely to be driven by rapid population growth, higher disposal income, improvement in the living standards, better education and information about health nutrition. The government of Malaysia in its effort to reduce the trade deficit introduced a new agricultural program in the Ninth Malaysia Plan. The plan geared towards changing the orientation of Malaysia agricultural to produce the higher value added and commercially-oriented products.

Food processing industries (FPI) generates higher value added for agricultural commodities as it converts raw material from agricultural farm to intermediate inputs or readily consumed products. Food processing industries with controlled and hygiene safe environments transform the product to be more hygienic and, therefore, marketable with prolong expiration date and far-reaching accessibility. This is a crucial cycle in the agribusiness system that is to deliver agricultural products from the raw materials in the farm to readily made products for consumers.

The present study investigates efficiency and productivity growth of the Malaysian FPI and identifies its determinants during the period of 2000-2006. The format of the analysis is a two-stage study design. The first stage uses non-parametric approach (data envelopment analysis - DEA) to investigate the efficiency and productivity growth of the Malaysian FPI. The second stage uses tobit regression method to identify determinants of productivity growth. Malaysian FPI can be divided into two groups: small and medium enterprise (SMEs) and large-scale enterprises (LSEs).

In the present study, the average technical efficiency (TE) in the SMEs is 75.6 percent based on constant returns to scale (CRS) and 95.4 percent based on variable returns to scale (VRS) during the period of observation. The technical efficiency (TE) value of 75.6 signified the ability of the SMEs to expand their output by as much as 24.4 percent using the same quantity of input. TE in the LSEs was 0.683 based on CRS and 0.952 VRS, means the industry potentially can increase output as much as 31.7% using the same quantity of input.

Total factor productivity growth (TFPG) in the SMEs was a mere negative 1.3 percent, contributed by technical efficiency change (EFFCH) value of 1.3 percent and technological change (TECH) value of -2.6 percent. In stark difference to the SMEs, TFPG for the LSEs was a healthy 7.3 percent, contributed by EFFCH value of 3.1 percent and TECH value of 4.2 percent. The findings revealed crucial information about foremost problems faced by the SMEs, i.e., TECH factor, during the period of observation. On the other hand, TECH was the main contributor to a positive TFPG in the LSEs.

High-productivity growth is an indication that the industries have efficient production, excellent management perform and high profitability. Therefore, the study identified high productivity growth industry as the highly potential sub-industry in the Malaysian FPI. The high-valued TFPG sub-industries in the SMEs were companies involved in the manufacturing of palm oil, refined palm oil, noodle and snack and, processing and preserving of poultry and poultry products. The sub-industries with low-valued TFPG and needed attention for improvement were companies involved in the manufacturing of tea, starch, palm kernel oil, glucose and milk. In the LSEs, the high-valued TFPG sub-industries were companies involved in the manufacturing of alcohol, flour, oil from other vegetables, palm kernel oil and processing and preserving meat and other meat products. The sub-industries that needed attention because of low-valued TFPG were companies involved in the manufacturing of chocolate and, processing and preserving of poultry and poultry

products. For these lower TFPG sub-industries, improvement strategies should be formulated by the government at the national level and by the management at the firm level.

From the theoretical framework, the study managed to identify the endogenous and exogenous factors affecting the productivity growth. For the SMEs, the study identified four positive determinants of productivity growth. The determinants were R&D (affecting TECH and TFPG), public infrastructure (affecting EFFCH, TECH and TFPG), foreign direct investment (affecting EFFCH, TECH and SECH), and foreign ownership which affecting all dependent variables. Negative determinant of productivity growth was openness (affecting TFPG and TECH).

Determinants of productivity growth for the LSEs were training cost (affecting TECH, EFCH and SECH), IT expenditure (affecting EFFCH and TFPG), openness (affecting EFFCH and SECH), and foreign ownership which affect all dependent variables. The negative factors were non-university graduate labor (for SECH and EFFCH) and energy price (for TFPG). The process of improving efficiency and productivity growth of the Malaysian food processing industry is a long-term strategic plan to develop and promote the domestic-food production. The benefits were two folds; producing import substitution and increasing value-added products. As identified in the study, four factors, i.e., R&D, FDI, public infrastructure and foreign ownership were crucial determinants of the TFPG in the Malaysian food processing industry.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai
memenuhi keperluan untuk ijazah Doktor Falsafah

FAKTOR-FAKTOR PENENTU PERTUMBUHAN PRODUKTIVITI INDUSTRI PERKILANGAN MAKANAN DI MALAYSIA

Oleh

YODFIATFINDA

April 2012

Pengurusi : Profesor Mad Nasir Shamsudin, PhD

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Malaysia adalah pengimport bersih produk makanan sejak dua dekad lalu. Nilai import makanan mengalami pertumbuhan dari RM 8.2 bilion pada tahun 1996 kepada RM 28.0 bilion pada tahun 2008, menjadikan defisit perdagangan produk makanan semakin besar iaitu dari RM 10.1 bilion, berbanding dengan RM 4.2 bilion pada tahun 1996. Kecenderungan permintaan untuk makanan yang diproses terus meningkat. Peningkatan ini didorong oleh pertambahan penduduk, pendapatan yang lebih tinggi, peningkatan pendidikan, taraf hidup dan maklumat mengenai kesihatan . Untuk mengurangkan defisit ini, kerajaan telah memperkenalkan program pertanian baru dalam Rancangan Malaysia Kesembilan dengan orientasi yang lebih besar terhadap pengeluaran komersial pertanian moden untuk menghasilkan nilai tambah yang lebih tinggi.

Industri Perkilangan Makanan (IPM) menghasilkan nilai tambah yang lebih tinggi untuk komoditi pertanian kerana ia memproses bahan mentah menjadi bahan perantara atau pun menjadi produk yang terus dapat dipakai oleh pengguna. Proses ini dapat membuatkan produk lebih bersih dan membolehkan ia tahan lama. Ini adalah tahap penting dalam sistem perniagaantani, untuk menghasilkan produk makanan dari ladang pertanian sampai ke pengguna.

Kajian ini menyelidiki kecekapan dan pertumbuhan produktiviti IPM di Malaysia dan mengenalpasti faktor-faktor penentu dari 2000-2006. Analisis dilakukan dalam dua tahap; yaitu 1) pendekatan *non-parametrik* - Data Envelopment Analysis (DEA) digunakan untuk menyiasat kecekapan dan pertumbuhan produktiviti, dan 2) kaedah regresi tobit digunakan untuk mengenalpasti faktor-faktor yang mempengaruhi pertumbuhan produktiviti. Dalam kajian ini, IPM di Malaysia dibahagikan kepada dua kelompok: industri kecil dan sederhana (IKS) dan industri skala besar (ISB).

Secara empirikalnya, analisis terhadap IKS memperlihatkan hasil purata kecekapan teknikal (TE) adalah 75.6 peratus berdasarkan skala pulangan tetap (*constant return to scale* - CRS) dan 95.4 peratus berdasarkan skala pulangan berubah (*variable return to scale* - VRS) dalam tempoh tersebut. Ini bermakna bahawa IKS dapat memperluaskan lagi pengeluaran sebanyak 24.4 peratus dengan menggunakan jumlah input yang sama. Pertumbuhan purata TE, memperlihatkan kecenderungan turun naik sepanjang tahun. Nilai TE pada ISB adalah 0.683 dan 0.952 masing-masing berdasarkan CRS dan VRS.

Dalam kajian ini, didapati bahawa IKS mengalami pertumbuhan *Total Factor Productivity (TFP)* yang negatif sebanyak -1.3 peratus yang disumbang oleh perubahan kecekapan teknikal (EFCH) sebanyak 1.3 peratus dan perubahan teknologi (TECH) sebanyak -2.6 peratus. Maklumat ini mendedahkan bahawa IKS menghadapi permasalahan dalam hal TECH selama tempoh pemerhatian. Berbeza dengan IKS, ISB mengalami pertumbuhan TFP sebanyak 7.3 peratus yang disumbang sebanyak 4.2 peratus oleh EFCH dan 3.1 peratus oleh TECH.

Pertumbuhan produktiviti yang tinggi bermakna bahawa industri telah mencapai proses pengeluaran yang lebih cekap, pengurusan yang baik dan perolehan pendapatan yang lebih tinggi. Kajian ini juga telah mengenalpasti sub-industri IPM di Malaysia yang mempunyai pertumbuhan TFP yang tinggi. Industri tersebut ialah pemprosesan dan pengawetan itik dan ayam itik, pemprosesan minyak sawit mentah, pemprosesan minyak sawit bertapis, pembuatan mi dan pembuatan snek. Sebaliknya, sub-industri yang perlu mendapat perhatian lebih lagi untuk pembaikan adalah sub-industri pembuatan teh, pati, minyak rong kelapa sawit, glukosa dan susu. Sub-industri di ISB yang memperlihatkan pertumbuhan TFP tinggi adalah pembuatan alkohol, pembuatan minyak dari sayuran lain, pemprosesan dan pengawetan daging, minyak rong kelapa sawit dan pembuatan tepung. Sub-industri yang perlu mendapat perhatian khusus ialah pemprosesan dan pengawetan produk itik dan ayam itik dan pembuatan coklat kerana pertumbuhan TFP yang menurun.

Untuk IKS, faktor yang berpengaruh positif adalah R&D (mempengaruhi TECH dan TFPG), infrastruktur awam (mempengaruhi EFCH, TECH dan TFPG), *pelaburan langsung asing* (mempengaruhi EFCH, TECH dan SECH), manakala pemilikan asing dalam syarikat mempengaruhi semua pembolehubah dependen. *Openness* pula adalah faktor penentu negatif (mempengaruhi TFPG dan TECH).

Faktor penentu pertumbuhan produktiviti bagi ISB adalah kos latihan pegawai (mempengaruhi TECH, EFCH dan SECH), belanja teknologi maklumat (mempengaruhi EFCH dan TFPG), *openness* (mempengaruhi EFCH dan SECH), dan pemilikan asing (mempengaruhi semua pembolehubah dependen). Faktor-faktor yang memberi pengaruh negatif ialah jumlah tenaga kerja yang bukan berkelulusan universiti (mempengaruhi SECH dan EFCH) dan harga minyak (mempengaruhi TFPG).

Hasil kajian menunjukkan bahawa peningkatan kecekapan dan pertumbuhan produktiviti IPM di Malaysia merupakan strategi pembangunan yang mempunyai manfaat ganda, iaitu untuk menggalakkan pengeluaran makanan domestik sebagai pengganti makanan import dan meningkatkan nilai tambah yang lebih tinggi bagi produk pertanian. Dalam kajian ini, R&D, pelaburan langsung asing, infrastruktur awam dan pemilikan asing didapati sebagai faktor-faktor penentu penting bagi TFPG dalam industri pemprosesan makanan di Malaysia.

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I certify that an Examination Committee has met on 19 April 2012 to conduct the final examination of Yodfiatfinda on his Doctor of Philosophy thesis entitled "Determinants of Productivity Growth in the Malaysian Food Processing Industry" in accordance with Universities and Universitiy Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

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DECLARATION

I hereby declare that this thesis is based on my original work except for quotation and citations, which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Putra Malaysia or at any other institution.

YODFIATFINDA

Date: 19 April 2012

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LIST OF ABBREVIATION

ADF	AUGMENTED DICKEY FULLER
AFTA	ASEAN FREE TRADE AGREEMENT
AE	ALLOCATIVE EFFICIENCY
ASEAN	ASSOCIATION OF SOUTHEAST ASIA NATIONS
CRS	CONSTANT RETURN TO SCALE
DEA	DATA ENVELOPMENT ANALYSIS
DMU	DECISION MAKING UNIT
DRS	DECREASING RETURN TO SCALE
EE	ECONOMIC EFFICIENCY
EFCH	TECHNICAL EFFICIENCY CHANGE
EU	EUROPEAN UNION
FDI	FOREIGN DIRECT INVESTMENT
FPI	FOOD PROCESSING INDUSTRY
FOWE	FOREIGN OWNERSHIP
GDP	GROSS DOMESTIC PRODUCTS
HDC	HALAL DEVELOPMENT CORPORATION
IMP	INDUSTRIAL MASTER PLAN
ISIC	INTERNATIONAL STANDARD INDUSTRIAL CLASIFICATION
ITEXP	INFORMATION and TECHNOLOGY EXPENDITURE
IVA	INDUSTRY VALUE ADDED
JAKIM	JABATAN KEMAJUAN ISLAM MALAYSIA
LSE	LARGE SCALE ENTERPRISE
LSE	MAXIMUM LIKELIHOOD ESTIMATION
MLE	MAXIMUM LIKELIHOOD ESTIMATION

MSIC	MALAYSIAN STANDARD INDUSTRIAL CLASSIFICATION
NEP	NATIONAL ECONOMIC PLANNING
NPC	NATIONAL PRODUCTIVITY CORPORATION
OLS	ORDINARY LEAST SQUARE
PECH	PURE EFFICIENCY CHANGE
RM	RINGGIT MALAYSIA
RND	RESEARCH and DEVELOPMENT
SFA	STOCHASTIC FRONTIER ANALYSIS
SMIDEC	SMALL and MEDIUM INDUSTRIAL DEVELOPMENT CORP.
SME	SMALL and MEDIUM ENTERPRISES
SECH	SCALE EFFICIENCY CHANGE
TECH	TECHNOLOGICAL CHANGE
TOP	TOTAL OPERATIONAL PRODUCTIVITY
TP	TECHNOLOGICAL PROGRESS
TFI	TECHNOLOGICAL FACTOR INDEX
TE	TECHNICAL EFFICIENCY
TFP	TOTAL FACTOR PRODUCTIVITY
TFPG	TOTAL FACTOR PRODUCTIVITY GROWTH
TRAIN	TAINING COST
USD	UNITES STATE OF AMERICAN DOLLAR
US	UNITES STATE OF AMERICA
VRS	VARIABLE RETURN TO SCALE

CHAPTER 1

INTRODUCTION

This study investigates productivity growth and the determinants of the Malaysian Food Processing Industry (FPI) by employing the non-parametric approach of Data Envelopment Analysis - DEA. The earlier studies about productivity, dated back since five decades ago were primarily based on input cost and output price, which is also known as price index approach. The essence of the price index approach assumes that firms are operating at full level of efficiency with maximum output and minimum cost.

The previous technique of productivity analysis suggested the output be weighted by factor price, and input be weighted by factor cost. The modern technique, however, extends it further by covering non-pricing data with various units of measurement. In other words, the old technique depends on the value of physical input and output, while the new technique includes both tangible and intangible factors. These factors such as the number of worker, education level, innovation, size of an organization and its location can be included in the analysis. The new technique makes the productivity analysis broadly applicable to even nonprofit organizations, as well.

It is vital to use a reliable method to obtain a consistent and an unbiased result in a productivity analysis. This is especially true when conducting time series analysis or comparison analysis among organizations. The process of selecting the appropriate method for any analysis depends heavily on the format and availability of data. Recently, quite a number of organizations concur on the benefits of recording operational data, which is crucial for productivity analysis. Smith (1973) argued that improvement in productivity cannot be measured by any method, no matter how sophisticated it may be, unless the necessary data is available.

The three principal economic sectors that contribute to the Gross Domestic Product (GDP) of most countries are agriculture, manufacturing and services. Contributions from these three sectors vary for every country. The contributions depend on the country's current economic development stage. For developed countries, the agriculture's share in the country's GDP may demonstrate a downward trend, and on the contrary, the manufacturing sector's contribution may show an upward trend. This is a common phenomenon for countries embarking on the manufacturing-based economy. Processing of primary products, especially agricultural commodities lead the country to gain from the higher valued added. However, the agricultural sector is an important sector because of its roles as the main provider of raw material for the manufacturing sector, primarily food processing industry.

The close relationship between the agriculture sector and the manufacturing sector can be witnessed in the food chain and the agribusiness system. Most of the primary products from farms need to be processed before reaching the consumers. For agro-based producers, however, it seems benefited to sell their products directly to the processing industry because of lesser demand for quality products. The end consumers, on the contrary, require fresh products from the agro-based producers. In addition, processing industry is more accessible and preferable by the small farmers due to economics of scale, less seasonal and price fluctuation.

1.1 Background of Study

The exploration in search of food sources fascinated man since the beginning of civilization. Today, food preparation is not a straightforward business anymore. It is a complex system involving many parties and activities, and the raw materials changed hand a few times before finally processed into a final product. The activities involved in the food preparation include production, processing, preserving, storage, transportation, pricing, marketing and distribution. Food is an essential part of human life, and it dictates the way people live in the society. In many nations, food issues have a close relationship to the economic, political and security stability.

The old school of thought treats food as a means for human survival, to be sought after and consumed. This thought no longer hold truth. Food decorates people's life, creates a culture in a country and provides employment for people. McMichael (1999) described the power of food lies in its material and figurative functions of connecting among nature, human survival, health, traditions and livelihood as a focus of resistance to the life itself. In bilateral trade, food can be used as a guarantee during the process of bargaining of traded commodities between two trading partners.

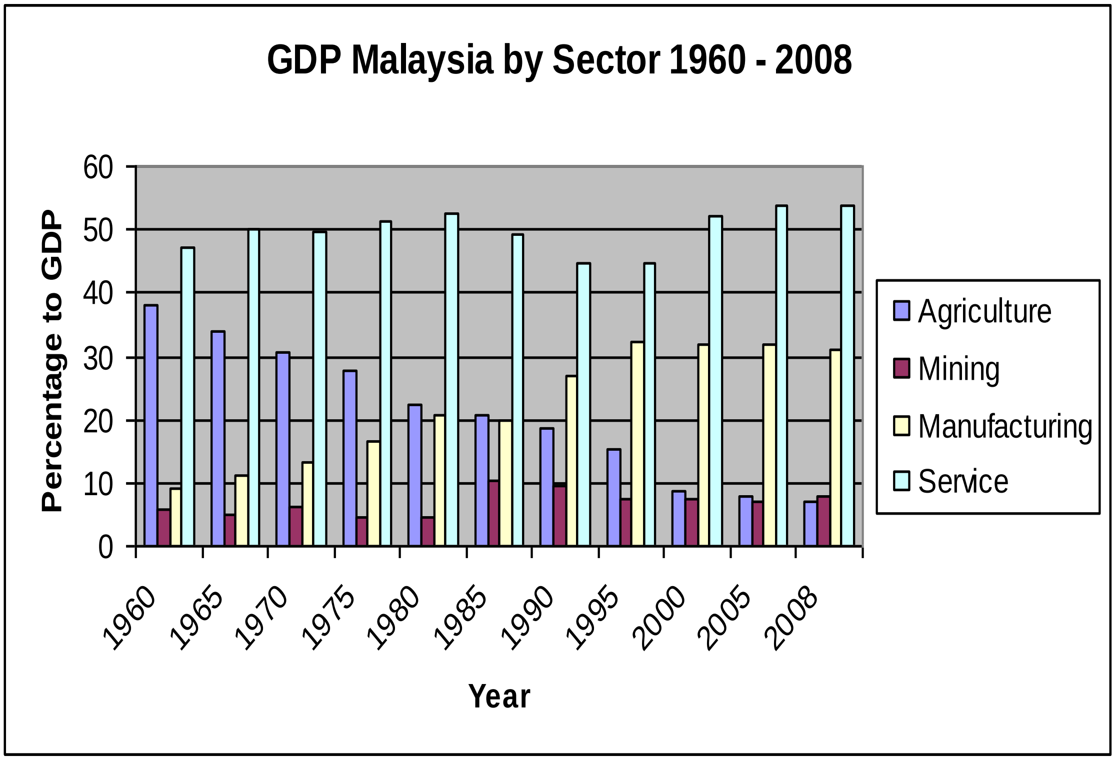
A nation will seek an advantage over other nations in order to protect its own domestic industry by letting the oversupply of its own agricultural products in the market. Historically, most nations, firstly, developed strategies for adequate supply of food for their own citizens. However, globalization era brought many new policies including for food-for-people program. Globalization reduces, and sometimes, removes all obstacles that hinder the smooth flow of commodities, funds, services and labor between national borders. Now, countries with limited domestic natural resource can venture abroad and use up the resources for their own food program. As a result, the influx of foreign investment grew over the years including in the agricultural sector.

Globalization creates more open economic regime. Nowadays, surviving and keeping the existence in the new and competitive global market is the name of the game. Organizations have to improve their productivity and competitiveness in order to survive. Therefore, evaluating an organization's performance during this trying time attracts the attention of all decision makers. Efficiency and productivity are the two most significant indicators used by economists and researchers when conducting performance analysis. These two indicators became a frequent theme in the present macro and micro economics discussion. Given its importance to economic growth and industry's performance, recognizing the factors influencing productivity is, therefore, a critical issue.

1.1.1 Development of Food Processing Industry (FPI) in Malaysia

Since her independence in 1957, Malaysia applied various development strategies to strengthen the economic performance fundamentals. The government started the intervention programs to help with the production, distribution and marketing of the primary agricultural products. The objectives of the strategy were to provide an adequate supply of foods, generate employment and eradicate poverty among the people. The strategy targeted at the urban poor and rural community due to their direct involvement in the agricultural sector. During the first Malaysia Plan (1966-1970) as much as 55.12 percent of the employment was created by the agricultural sector. For decades, these strategies had brought some success to Malaysia's economy. This was evidence with the increase in the production of several primary agricultural commodities. Commodities like rubber, palm oil, pepper, cocoa and timber contributed enormously to the Malaysia's economy. Malaysia was the largest rubber producer in the world until 1980s.

Figure 1.1 shows the share of the agriculture sector to the Malaysia GDP from 1960 to 2008. During this period, the agricultural sector shares were as much as 38 percent of the Malaysia's GDP, second only to the services sector which stood at 47 percent. This condition became the driving force for the future economic growth and the foundation for the development of industrial-based economy.



Source: Malaysia Plan (various issues) and the Department of Statistic Malaysia

Figure 1.1 Share of Economic Sectors to the Malaysia GDP 1960 to 2008

Especially for the period of 1960 to 1985, the agriculture sector share in Malaysia's GDP was more than 20 percent. All the while, the sector experienced a declining trend which continued until 2000 and the share dipped to be less than 10 percent. The latest figure taken in 2008 showed that the share stood at 8.6 percent. The graph showed a contrasting trend between the share of the agriculture sector (descend) and the manufacturing sector (ascend). This “X form” phenomenon is quite common in the developed countries where manufacturing sector usually has a higher share than the agricultural sector. Deficit of food trade not only the case of Malaysia, this is occur in most of other Asian countries as reported by Abott et al., (2008).

The significant growth recorded by the manufacturing sector led the Malaysia able to maintain its unemployment rate to a manageable level. It stood at 3.2 percent in 2007 and 3.3 percent in 2008. At this juncture, there was a shifting of labor force utilization in the country. The agriculture sector experienced a reduction in percentage of its labor force from the total national employment. Employment in the agriculture, forestry, livestock, and fishing industry dropped from 26 percent in 1990 to 18.4 percent in 1999. On the other hand, the manufacturing sector witnessed its share in the total national employment increased from 19.9 percent in 1990 to 22.5 percent in 1999 (Ghani, 2001). Ahmed (2006) investigated partial and total productivity of the Malaysian manufacturing sector using data from 1971- 2001. He found increasing productivity on the gross output and the material but decreasing on labor productivity as shown in Table 1.1.

Tabel 1.1 Total Productivity and Partial Productivity in the Malaysian Manufacturing Sector 1971-2001

	1971-1979	**1980-1986**	**1987-2001**
TFP	0.61	0.44	-0.11
Gross output	11.4	14	17.1
Capital	11.3	15.9	14.8
Labor	10.8	9.39	5.93
Material	10.2	14.1	16.7

Source: Ahmed (2006)

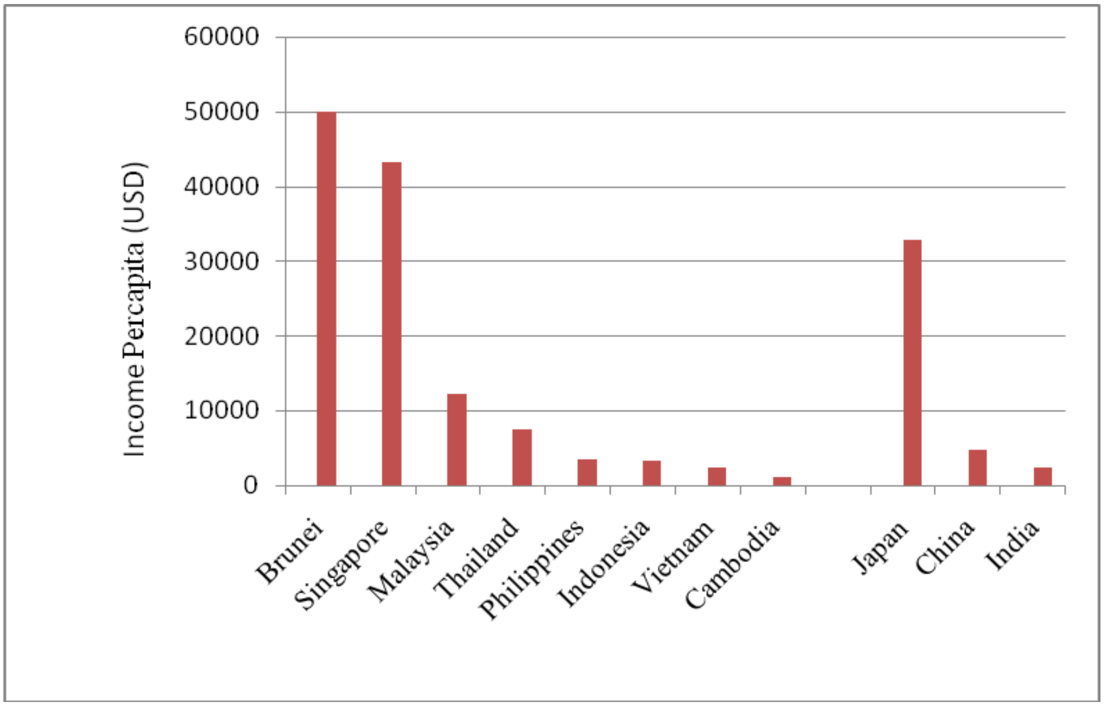
A country tends to transform its status from a producer of primary agro-based commodities to a producer of processed-food products as its economy progresses. For example, the restructuring of Association of South East Asian Nations (ASEAN) economy since 1980's fostered the exports performance and the influx of foreign direct investment. These structural reforms made ASEAN countries changed their economic profile from an exporter of raw agricultural commodities to an exporter of processed-agricultural and food products (Ahmad and Mad Nasir, 2008). Table 1.2 shows the agricultural sector's contribution to GDP in the selected ASEAN countries. Except for Brunei Darussalam, the rest of the countries showed a declining trend. Malaysia and Vietnam in particular experience with contribution of agricultural sector to the GDP shrunk almost 50 percent in two decades.

Table 1.2 Contributions of Agricultural Sectors to the GDP (%) in Selected ASEAN Countries

Country	1990	1995	2000	2005	2008
Brunei	2.4	2.5	2.7	3.1	3.3
Indonesia	19.4	17.1	15.6	13.1	14.0
Malaysia	15.2	12.9	8.8	8.7	7.14
Philippines	21.9	21.6	15.8	14.3	13.8
Thailand	12.5	9.5	9.0	8.9	11.4
Vietnam	38.7	27.2	24.5	20.9	19.5

Sources: Ahmad and Mad Nasir (2008), EPU (2009)

During the last three decades, Malaysia achieved significant progress in economic growth, increased its per capita income and attained a higher standard of living. Referring to figures released by the United Nation, Malaysian's gross per capita income in 2006 was US$ 12,160. This placed Malaysia third among ASEAN countries beneath Brunei Darussalam and Singapore (Figure 1.2). The nation sustained its development progress during the New Economic Policy (NEP) in 1971-1990 with an average growth of 6.7 percent per annum. The momentum accelerated further during the Sixth Malaysian Plan with 8.7 percent growth per annum (Seventh Malaysian Plan, 2002).

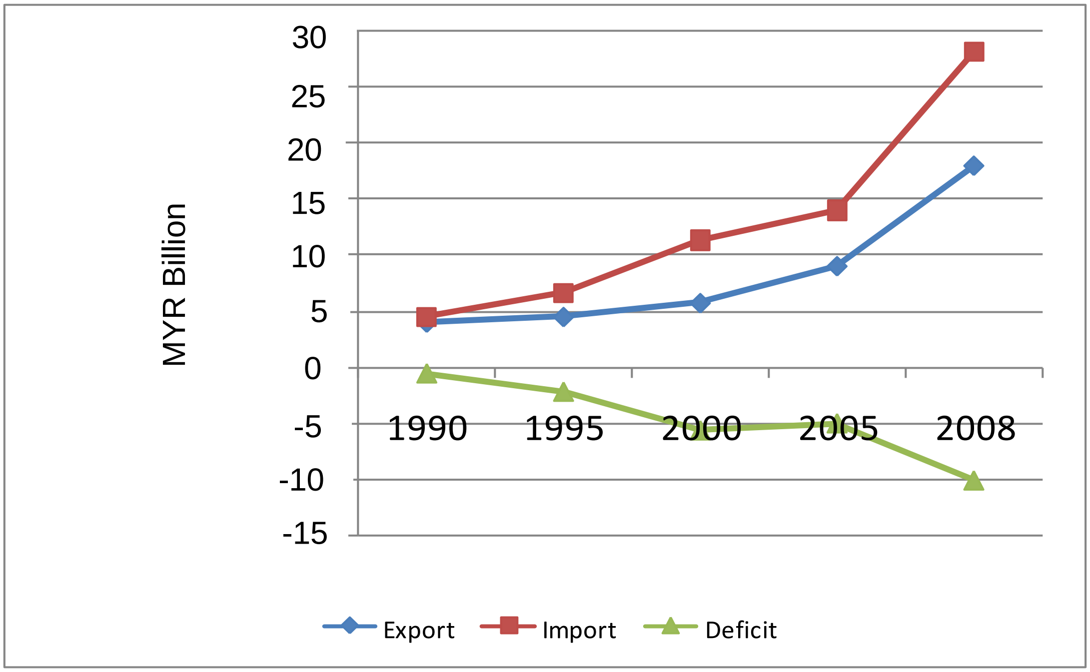


Sources: FAO Stat, the United Nation (2009)

Figure 1.2 National Gross Income per Capita for the ASEAN countries, Japan, China and India in 2006

The inauguration of the National Agricultural Policy (NAP) in 1984 highlighted government's intention to promote growth in the agricultural sector by drafting comprehensive policies about it. Growth in the agricultural sector has a distinct effect on growth in other sectors including sector involved in the processing of raw agricultural commodities (Mustapha, 1989). Wong (2007) indicated that urbanization gave rise to growth in population, increase in income per capita, change in lifestyle, and as a consequence, heighten the demand for food and stimulate changes in dietary habits.

Currently, Malaysia is a net importer of food products. The last two decades witnessed the significant increase in demand for the processed food. This upward trend was the result of rapid expansion of the population, higher household disposal income; improvement in the living standard, higher education, and high-availability of information about healthy nutrition. Figure 1.3 shows balance of food trading in Malaysia from 1990-2008. The cost of imported food grew from RM8.2 billion in 1996 to RM17.9 billion in 2005; spawning a larger trade deficit of RM7.2 billion, compared with RM4.2 billion in 1996 (MIDA, 2007). The trade deficit had been increasing quite sharply from 2005-2008.



Source: Department of Statistics (2006), Malaysia Plan, various issues

Figure 1.3 Balance of Food Trading in Malaysia, 1990-2008

Over the last two decades, Malaysia had a significant increase in food trade deficit. This is conclusive evidence that Malaysia is still relying heavily on imported food product for domestic consumption. Not until recently, this problem has attracted serious concerns and debates from a wide range of subjects including the policy makers, economic practitioners and researchers. As a result, the government had drawn up and implemented various strategies and policies at various levels of the community aiming at narrowing the food trade deficit. Amongst strategies formulated was revitalization of the agricultural sector, invigoration of food processing industry, and adoption of modern technology in farms and food processing companies. Ahmad et al. (2001) articulated the importance for countries with high-dependency on imported food products to take cognizance of the economic and currency stability. Importing products, including food, may not be so desirable during economic and currency instability. Therefore, he suggested for those countries to import most essential food products only.

Economists and researchers alike made a concerted effort to understand the complexity of today's food price. Their findings described intricate interplay among many current global factors that directly influencing the food price. They noted that fluctuation of crude oil price, currency instability, imbalance of supply and demand of food, and trade policy made by nations in the world are among those factors. Besides, two more factors worthy of mentioning are rapid economic growth of countries like China and India and human continuous yearning for a better life. The last two factors put pressure on the global commodity producers.

Positive economic growth means that people become more affluent their customary diet change. People are in the lookout for healthy and better food led the demand for food increases. In addition, the soaring of energy prices and the depletion of energy deposit cause people to look for an alternative energy. They turn to bio-fuel, which originates from agriculture commodities like palm, soybean, corn, sunflower seed and peanut. This phenomenon puts policy-makers under real dilemma as they have to decide on the usability of these agriculture commodities, for food or fuel. Abott et al. (2008) said that the condition becomes a difficult challenge for public and private leaders to identify the policy choices. Those policies should help the world deal with the real problems of the rising food prices without sacrificing the aspirations for the future.

Mad Nasir and Arshad (2008) extended the above argument by two significant factors that cause the escalating of food price. The first factor is the demand factor, which, induced by the hike of income per capita, growth in inhabitants and surge in interest on bio-fuel - increase in price of crude oil. The second factor is the supply factor, which, caused by the loss of crop due to climate change, hike in commodities price and transportation cost due to rising of oil prices, and low investment in agricultural productivity and technology. Food industry allocates around 30 percent of their production cost on energy. Hence, fluctuation in energy price influences the productivity growth of the industry.

Regmi and Gehlhar (2005) argued that consumer's preference primarily shaped by the incomes, changing in lifestyles and cultural. Consumers with higher income tend to have their dietary change to protein-rich foods. This will increase demand for meat, dairy products and other high protein food products. In line to this condition, Makki et al. (2004) found that higher-income population in developed and developing countries tend to consume a larger quantity of processed food. This trend is consistent with Malaysian's food consumption pattern within the last decade show increased the demand for meat and dairy products significantly.

In the Ninth Malaysian Plan, the government introduced new programs and policies for the agricultural sector. One of the most prominent agendas of this plan was the transformation of the agricultural sector into a modern and vibrant industry. Modern agriculture capitalized on the adoption of advance technologies and highly-tuned production processes. The government hoped the industry would grow into a large-scale commercial production, producing high value added of agro-based products, with wider application of information technology and biotechnology. The agricultural development policy aimed to balance the agricultural growth in relation to the industrial growth through efficient utilization of national resources.

In this context, higher value added gained by having the facility to process agricultural commodities and transform it into a final product at the proximity of the consumer's demand. Based on this prior knowledge the industry would be able to satisfy the consumers with an edible and healthy food with an interesting packaging, and most importantly readily available. Consumers' willingness to pay extra for a superior product lead to a positive growth in demand on processed foods. Over the years, many developed countries have benefited from this modern-food industry.

1.1.2 Productivity in the Food Processing Industry

The common objectives of companies in the Food Processing Industry (FPI) are to produce food products that are hygienic, safe for consumption and healthy for the consumers. The products should also be marketable and transportable to remote places, and most importantly have longer expiration date. Benefits that food processing industry brings to mankind are: (i) human health (removal of toxin, preservation of food, information on nutrition enrichment), (ii) creating value added (capital, employment, income for the rural inhabitants) and (iii) produce environmental friendly products (degradable waste and green energy).

FPI around the world depends heavily on a continuous supply of raw materials. These raw materials usually either supplied by local farmers or imported from other countries. The government through its agency, agriculture department, controls and monitors the supply and demand of these raw materials. Characteristics of the agricultural commodities are perishable, seasonal and bulky. These characters are part of the production constraints in the FPI. As raw material source of FPI, the agricultural sector receives indirect pressures like rivalry use of land, environmental conservation policy, and fluctuation in energy price. Therefore, the FPI needs to operate efficiently and improve their productivity through optimal resource allocation. They need to shift their production paradigm from input-driven to productivity-driven strategy.

Productivity is a comparative variable which has close relationship with competitiveness. There is a consensus among the economists who argue that productivity is a crucial factor for every company or industry. Spithoven (2003) and Pritchard and Roth (1991) argued that productivity growth determines the living standard of people in a country. A company with high productivity shows a tendency to optimally allocate resources which in turn enables it to produce maximum output from the same level of resources available. This high productivity can be associated with factors such as capital intensity, labor productivity and total factor productivity (TFP). Productivity also indicates efficient utilization of resources to produce goods at lower unit cost, higher quality, and at the same time be able to pay better wages for workers. Some of the factors that influence productivity are skill and education level of workers, R&D, improvements in organizational structure and human resources management, adoption of new technology and innovation.

Sudit (1984) noted there are at least five benefits of TFP analysis. First, it gives the stockholders, employees and customers the ability to see the varying degrees and trends of productive efficiency of an organization over time. Productivity trends have a direct bearing on the most salient aspects of company's performance such as the rate of return of investment to stakeholders, the quality and morale of company’s human organization, and customer loyalty. Secondly, it gives relative measures of productive efficiency among firms by comparing the TFP level within the industries. This undertaking allows an organization to get an idea of its own productive efficiency in relative to other industries under the same economic condition. Thus, competitive goals can be formulated in order to improve business performance in future. Third benefit of TFP analysis is that it can be used as a basis for long and short term forecasting by using past productivity levels data. The forecasting should answer a few pertinent questions like whether a product lifespan should be extended, type and number of new inputs to be introduced, should the cost be minimized, and policy on capital budgeting. Fourth, it forms a comprehensive productivity database which open new, crucial avenues of research into factors affecting the productivity. The database also provides formulation data, production estimates and cost functions which contribute to the knowledge of basic economic characteristics. Fifth, it provides vital managerial implications for the public and regulated sector in evaluating efficiency levels.

TFP is the measure of efficient utilization of multi-input factors such as capital, labor and energy in order to produce outputs in the actual production environment. Since the 8th Malaysia Plan, the Malaysian government transformed its economic paradigm from input-driven to productivity-driven growth (NPC, 2008). It stated explicitly in the plan that "*enhancing productivity growth is essential for the achievement of high growth with price stability. In view of limited resources and capacity in capital accumulation as well as stiff competition in attracting foreign investments, it is necessary to accelerate the shift in the economic development strategy from input-driven to one that is productivity-driven by enhancing the contribution of TFP. The improvement in TFP will enable the economy to move to a higher production frontier, thus more efficient use of capital and labor. The TFP gives more emphasis on enhancing the education, skills and expertise of the labor force, improving management and organizational techniques, upgrading R&D, strengthening innovative capacity and protecting intellectual property rights as well as expanding the usage of information and communication technology (ICT)".*

The productivity analysis is a comprehensive endeavor includes measurement, interpretation and evaluation of productivity's performance and its progress over time. Measurement is the starting point of a long and lengthy process of productivity analysis. The next steps in the process include interpretation and evaluation of the results which is a vital part of the analysis. Productivity is one of the key indicators of industry performance (Rao et al., 1998).

1.2 Problems Statement

There are many published reports on the performance of the Malaysian FPI. Most of the studies revealed similar findings that the efficiency and the productivity growth of the industry were low. Kalirajan and Tse (1989) reported that the average technical efficiency of the Malaysian FPI stood at 0.73, which means the industry only producing about 73 percent of its potential output. Hence, more than a quarter of the production resources in the industry were not efficient use. Mahadevan (2002) calculated the total factor productivity (TFP) of the Malaysian manufacturing sector and found that the TFP in the FPI was declining from 0.78 to 0.69 during the period from 1987-1996. More comprehensive study by Alias Radam (2007) showed consistent conclusion that the food industry in Malaysia underutilized the potential production output by about 26 percent. The recent literature reported by Muhamad and Said (2010) reveals that 18 sub-industries in Malaysian food manufacturing industry have scale down and operating under the efficient frontier. These industries were advised to expand their scale of operations and conduct operation adjustments.

Nevertheless, these previous studies still pose a lingering question about what are the driving factors of productivity growth in the of Malaysian FPI. Knowledge about these determinants is crucial to a decision maker and the authority so that more comprehensive regulations can be drafted in order to improve the performance of this industry.

Trade deficit of agriculture and food products is on the rise since the last decade (see: Figure 1.3). The Malaysian FPI needs to step up their business to curtail this ever rising trade deficit. The industry needs to improve on its efficiency and productivity in order to reduce the capital outflow and strengthen the food security program.

The food products need stringent and meticulous preparation procedures before they can be approved for distribution in the market. There are many factors affecting consumer's preference such as ingredients, packaging, the side-effect on the human health, microbe contamination and expiry date are among those determinants that influence the consumer's choice. All the above-mentioned factors combined to provide the challenge for the growth and performance of FPI companies. Besides, food products are risky merchandise to be imposed a non-tariff barrier by the importing countries. Some importing countries used this non-tariff barrier as a tool to control the quantity of imported goods. In many cases, the importing country rejects food products because of nonconformance under their domestic health regulation.

Consumer’s awareness on food safety heightened because of the high-availability of information on various media, for example, the internet, television, books and magazines. News about contaminated food products spreads thick and fast around the globe. As an example, the case of milk contaminated with melamine in China at the beginning of 2008 where it became an international issue within two days after media exposure. As a consequence, China's dairy industry spiraled downward ever since. Another example, the mad cow case (BSE) that threatened meat industry in America and Europe; the industry lost billions of dollar within a week after the discovery of its first case (Ortega et al., 2009).

Other issues that pose a challenge to the FPI are energy crisis and environmental degradation issues. These subjects are the world concerned; governmental or nongovernmental people alike, wary about these issues. The challenge to any sectors, including the FPI is how to sustain the growth without affecting the environment. The campaign to popularize the usage of renewable energy, such as bio-fuel and oil-seed, has been highlighted since few years ago. The campaign brought new competition into the market as demand and supply of the raw materials got more intense. Dieu (2006) reported that rapid growth of food industry in Vietnam gave impact to environmental deterioration. These environmental problems may affect future prospects of the country's industrial growth, including the food industry. Therefore, the industries must adjust the technology used in the production, be more customer-oriented and apply demand-supply management to keep the industry exist in the high competition market.

The small and medium enterprises (SMEs) dominate the Malaysia FPI. In general, these SMEs face almost the same problems that they are technologically out-of-date, use substandard raw materials and have least product innovation. The industries have no financial strength and capability to invest in R&D and revitalize their production equipment. Lack of understanding in the quality standards and management system is a common problem in the industry, especially to small companies. Some of the food industries in Malaysia that produce chocolate product, dairy product, meat and meat-related products still depend on imported raw materials. These facts led to promote a better understanding on the performance of food industry in Malaysia.

The Malaysian food processing industry needs to identify and rectify all the problems that hinder its progresses. Therefore, it is necessary for the investigation to be carried out to examine the efficiency and productivity growth of this industry. The investigation also attempts to identify the determinants that influence the productivity growth of this industry. In this study we will attempt to answer some of the questions pose at the beginning of the research. Research question like; In which sub-industry of the Malaysian FPI the productivity is lowest? Does this low-productivity affects all sub-industries or it varies?

1.3 Objectives of the Study

The general objective of this study is to identify the determinants, which affecting the productivity growth of the Malaysian food processing industry.

The specific objectives are:

1. to investigate the efficiency and productivity growth of the Malaysian food processing industry in each sub-industry,
2. to investigate factors affecting the productivity growth of the food processing industries, and
3. to identify the potential sub-industry of the Malaysian food processing industry in terms of higher productivity growth.

1.4 Significance of the Study

Food processing industry plays a crucial role to the Malaysian economy. This study contributes to the existing literature by furnishing it with the comparative figures of the industries over the period of 2000-2006. It also highlights the efficiency and productivity growth of the Malaysia food processing industry and factors affecting them. The study goes beyond traditional partial productivity analysis, and constructs total factor productivity analysis in the time variant as a performance indicator of the industries.

Many studies on the Malaysian FPI in the past, focused on measuring the efficiency and productivity using endogenous variable. The present study extends the scope of the previous studies to include an investigation on the determinants of the TFP growth for each sub industry. The investigation uses the latest published data of the industry and exogenous explanatory variables in its research model. The findings from this investigation are useful to the government and industries' stakeholder in order for them to devise strategies to improve the performance of the food processing industry in Malaysia. Moreover, the result of this study adds to the growing literatures that employ data envelopment analysis to measure efficiency and productivity at the industry level. It also contributes to the future research on the Malaysian food processing industry.

It is vital to observe and monitor the performance of the Malaysian FPI as it progresses in the future. Few pertinent points to observe are the change in input allocation, the output growth rate, shifting in production growth and the factors influencing it. The information gathered helps the decision makers in the industry in evaluating and formulating new strategies to achieve the desired target. The government can monitor those sub-industries which the performance are below par but have high potential to grow. The government can then devise a strategy to help those sub-industries. This study is different to the previous studies for instance; the industry is divided into two group namely small medium enterprises and large scale enterprises. In addition to, the data used in this study is the latest data about Malaysian FPI based on new Malaysian Industrial Classification Code (MISC).

1.5 Organization of the Thesis

This study investigates the efficiency and productivity growth of the Malaysian FPI and the determinants influencing them. The FPI categorically divided into the small and medium-scale enterprises (SMEs) and the large-scale enterprises (LSEs). There are six chapters in this thesis. Chapter 1 presents an introduction about food processing in Malaysia and discusses in brief about productivity of food processing industry in Malaysia. It poses problem statement and objectives of this study. Chapter 2 presents a brief overview of the food industries in leading countries worldwide. Contribution made by these countries to the world trade of processed food and highlight of the current performance of the Malaysian food processing industries. Chapter 3 presents the literature review of food processing industries and researches conducted on the sector especially on efficiency and productivity growth. Also, this chapter discusses productivity issues (including efficiency as a component of productivity) and the concept of measuring productivity used in the previous study. Chapter 4 explains the methodology of the study, Chapter 5 reviews and discusses the results obtained from the study and finally Chapter 6 presents general conclusion of the study and recommendations for further research.

CHAPTER 2

MALAYSIAN FOOD PROCESSING INDUSTRY

Food processing industry (FPI) plays a pivotal role in the economy of both the developing and developed countries. This chapter provides general information about the FPI in Malaysia and a few other selected countries. The discussion centers on the function of FPI in the economy and the outlook for the current performance of the Malaysian FPI. Some countries do have advantages of the FPI development for the availability of capital and a modern technology, while other countries have advantages for the availability of raw material. Malaysia is now in the era of transformation for its industrial development. The indication, for instance, during 1970-1990 the country was an enormous producer of cocoa bean. However, currently cocoa bean is imported to fill the domestic chocolate industry. The Malaysia government has projected to doubling its per capita income from RM 22,000 in 2010 to RM 49,500 in 2020. The higher income of household is a factor influences the demand on food products, changes in diet and, preference on food products.

2.1 Introduction

Like other economic sectors, FPI has undergone a considerable change during the last fifty years. Innovation in the production technology such as new packaging material, biotechnology, food additive as well as innovation in the transportation and communication sectors has fueled the rapid changes of the FPI all over the world. Alfranca et al. (2003) noted around 45-50 percent of the innovations applicable in the agriculture and agro-base industry were adopted from the technology outside of the industry, and indirectly it influences the dynamic change of food market.

Dynamics of food market is significantly influenced by demand and supply fluctuation. Factors that influence the demand fluctuation are population growth, household disposal incomes and changes in the consumer's taste and preference. Pitt et al. (1990) includes gender as differential in food consumption of household in the low-income countries. Other factors that influence the supply fluctuation are growth of establishment, technology, energy price and availability of raw material.

In the manufacturing sector, FPI may be one of the least affected by economic changes. Many empirical studies stated that, during the economic downturn, the demand for processed food is relatively stable; in fact, consumers' expenditures dictate demand fluctuation. During the financial crisis in 1997-1998, many sectors including banking, tourism, garment and heavy industry suffered from the impact of the crisis. The least impacted are agriculture and agro-based sectors. In relation to this, as reported by MIDA (MIDA, 2007), the Malaysian food processing industries continue to thrive even during the economic recession. Decreasing value the exchange rate of the currency creates a favorable incentive for an exporter, especially when the production mainly uses local inputs. Value of processed food export has shown a larger dynamism than the primary export. In some developing countries, (Athukorala and Sen, 1998) noted that the degree of dynamism is comparable to the conventionally-defined manufacturing products.

Engel's law states that as income rises within a household, the proportion of money spends on foods' expenditures decreases. This phenomenon occurs in countries whose citizens are high-income earners. Bigger proportion of expenditures goes to items such as education, health and pleasure. However, total amount spent on food, particularly on processed food is not always decrease. Many empirical studies establish that consumers with higher incomes agree to pay more for high-quality food such as functional and organic food. Makki et al. (2004) pointed out that the world trade in processed food had been growing in response to increasing consumer demand for diversified diets.

A significant number of studies reported the FPI gave considerable contributions to the economy of many countries. Amongst the studies were, Bradley et al. (1995) in Ireland; Morrison (1997), Huang (2003), Regmi and Gehlhar (2005), Hossaina et al., (2005) in U.S.; Walkenhorst (2001) in Poland; Prescott et al. (2002) in East Asia and New Zealand; Menrad (2004), Cahill (2004) in Canada; Athukorala and Sen (1998), Kidane (2006) in Australia; Ali et al. (2007) in India, Amin (2007) in Indonesia; Alias Radam (2007), Thalib and Ali (2009) in Malaysia; Schiefer and Hartmann (2008) in Germany; Mikami and Tanaka (2008) in Japan; Dimara et al. (2008) in Europe and Dieu (2006) in Vietnam. The FPI noticeably contributes in a manner that it creates employment opportunities, provides value added and, increases income for people in the rural area. Food industry in the United Kingdom contributes 2.5 percent to the GDP and, about eight percent to the whole manufacturing value added (Watts, 1983). In terms of the regional outcome, Sok (2000) argued that FPI is essentially providing the stimulus for economic growth to rural areas by relocating the industry in the proximity of the farm land. This movement should appreciably be supported because it creates an even distribution of employment opportunities and encourages economic development for people in rural areas.

Hicks (2004) classified FPI into two distinct categories; conventional and modern food processing industries. The conventional industry is dominant in most of the developing countries and constitutes more than 70 percent of the total FPI companies. This industry is mostly family owned, employs 50 or fewer workers and caters mainly for domestic consumers. Other characteristics of this conventional category are; mostly manual and batch type processes and labor-intensive with minimal complexity. Usually, they use local fabricated equipment with low productivity and efficiency, limited quality control and research and development. Data released by the Department of Statistics Malaysia (2008) revealed that this conventional type company encompasses 90 percent of total food companies in the country.

The modern FPI proliferates in many developing countries all over the world. Some of the companies are the joint venture between large multinational corporations and local setups or indigenous companies. A modern FPI typically has a wider market than a conventional one, large capital investment and high-quality products. In his paper, Hicks (2004) mentioned that these modern FPI were initially set up to process food derived from meat, wheat and flour products and dairy products. In recent years, these companies started a project to process local fruits and vegetables. The products were then packed, labeled and exported using corporations' logos and brand names.

Consumers in the countries that have rapid economic growth, tend to transform their dietary behavior from primary cereal meals to more animal protein, fruit and vegetables. China is one excellent example for this phenomenon. China enjoyed impressive economic growth, with an average growth of 10.8 percent a year, within the last five years. In consequence, the demand for food, especially meat and fish increased significantly. Ortega et al. (2009) reported, since economic reformed in late 1990, meat consumption in China increased as much as 50.63 percent, mostly pork meat. In Netherland, Reijnders (2004) noted the same conclusion that the higher the income level of consumers, the higher the demand and willingness to pay for health, functional and processed foods. As the population increases and the country become more affluent, the demand for processed food grows, as well. Abott et al. (2008) suggested this transformation contributes to higher global demand on agricultural commodities than ever before. A rising world income causes higher consumption of primary-food products including cereal, vegetables and animal protein. The emergences of bio-fuel as a source of energy led to increase of grains and vegetable oils consumption since 2004.

In the context of globalization, Athukorala and Sen (1998) argued that the driving force behind the expansion of export is not traditional-primary goods, but indeed, new agro-based manufacturing activities (food processing industry). Countries can be grouped into three income categories namely; low, middle and high-income countries. The growth of processed food export from countries under their respective categories can then be monitored. The average percentage growth of processed food export for the three categories; low, middle and high-income countries; are 7.2, 10.8 and 12.17 respectively.

Eastern Europe, Asia and Asia-Pacific are three regions with high-populated countries and robust economic growth. These regions have the potential to be highly dynamic and robust market in the future. Southeast Asia region, with over 550 million people, is a bright and promising market of food processed products. However, Andersson (2001) found a contradicting result; some processed food products are substandard goods in Sweden. What it means is that, with the rising of the income, people have greater buying power; therefore, substandard products would no longer be in demand. The underlying reason presumably is the trend to consume more fresh food and less canned or frozen food.

2.2 Food Processing Industry in the Selected Country

This section presents a brief overview of FPI from a few selected countries in the world. The countries were selected based on their significance role in the food supply and consumption in the world. The United State and France are the first and the second largest exporter country for food products worldwide. China and India were selected due to their huge population and demand on food as well as due to availability of literatures about food industry of these two countries. Australia is selected due to a significant role to supply food product to Malaysia, mainly diary, meat and meat products.

Some countries are primary exporters of food products, for example, the United States of America, France and the Netherlands. At the same time, there are countries like the United States of America who is also the primary importer of food products. Other primary importers are Germany and the United Kingdom. Table 2.1 shows the leading exporters' and importers' countries of the food processed products in the world. The United States is currently the largest exporter and importer of the processed food products in the world. While countries like United Kingdom, Japan, Italy and China are mostly importer of processed food products. On the other hand, countries like France, Argentina, the Netherland and Canada are on the opposite as they are primarily exporters of processed food products. At present, global market for food product values at over RM12.6 trillion (US$3.5 trillion) and expects to grow at 4.8 percent annually to reach RM23.04 trillion (US$6.4 trillion) by 2020 (MIDA, 2007).

Table 2.1 The Main Food Trader Countries in the World

Exporters			Importers		
Rank	**Country**	**Share (percent)**	**Rank**	**Country**	**Share (percent)**
1	United States	8.9	1	United States	10.2
2	France	5.9	2	Germany	8.0
3	Netherlands	5.6	3	United Kingdom	6.5
4	Germany	5.4	4	Japan	6.2
5	Brazil	4.0	5	France	5.3
6	Spain	3.4	6	Italy	4.6
7	Belgium	3.4	7	Netherlands	4.4
8	China	3.3	8	Spain	3.8
9	Canada	3.2	9	China	3.8
10	Italy	3.1	10	Belgium	3.7
11	Argentina	2.8	11	Russia	2.9
12	United Kingdom	2.4	12	Canada	2.7
13	Thailand	1.8	13	Mexico	2.1
14	Australia	1.8	14	Australia	0.9

Source: Australian Food Statistic (2008), the share on the total value in 2007.

United States

The United States corporations account for 40 percent of the world top fifty food processing companies. The country is currently the largest exporter and importer of processed foods and beverages in the world (Wilkinson, 2004). The FPI in the United States is responsible for 26 percent of the worldwide production of the processed food. The combined sales of the 20 percent largest U.S. food processing companies were considerably higher than the combined sales of the next 80 percent of the companies. There are currently about 17,000 food manufacturing facilities in the U.S., down from 34,000 in 1947. The FPI is one of the United States' largest manufacturing sectors; accounting for more than 10 percent of all manufacturing shipments with the value of food shipments stood at $538 billion in 2006 (U.S. Department of Commerce, 2007).

The present state of U.S. food industry is a result of a long process of structural changes. The industry had featured an open competition, where large numbers of buyers and sellers traded homogeneously in an open market. As a consequence, vertical integration between companies becomes a sensible thing to do in order to acquire larger market penetration and economic of scale (Diabate, 2006). Connor and Geithman (1988) identified that there were 3460 acquisitions during 1947 until 1985. The larger and more superior companies merge with smaller companies in order to attain economic of scale, efficiency in production and higher profit margin. Lately, Nguyem and Ollinger (2009) investigated the effects of merger to employments, wages, and plant closures in the U.S. meat product industries. They found that mergers and acquisitions positively affected employment at plants acquired during 1977–1982, but not at those acquired during 1982–1987. The views that mergers and acquisitions cause people to be dislocated and lost their wages were unfounded.

Christy and Connor (1989) found that new technological advancement in the U.S. food industry gave rise to new and improved processes, thereby yielding new and high-quality products, thus altering the input mix and comparative-regional cost advantages. These advantages, also identified as institutional forces, include public policies at the national, sectorial, and state level. In addition to the above, Wilkinson (2004) revealed that long-term transformation of the food manufacturing sector would be influenced by three principal forces: economy, technology, and institution. Economic forces affected the food manufacturing include domestic demands, market structure, and international factors. Morrison (1997), who conducted a study about food and kindred products in the U.S. from 1965 to 1991, also concluded that investment in new technology affects structural change and economic performance through the effect on capital and input composition. This is particularly important for capital-intensive industries such as food processing, which lack short-run flexibility due to adjustment costs. The US manufacturing sector has annual TFP growth of 2.67 percent.

The FPI in the United States, traditionally, has had strong international presence. Rapid globalization of leading U.S. corporations and their products were due to several factors including the maturity of its domestic market, changes in some government regulatory laws and the potential for exploiting global brands. Some of the largest US food companies in 2007 are Nestle, Tyson Foods, Kraft Foods, PepsiCo, Anheuser-Busch, General Mills, Dean Foods, Smithfield Foods, ConAgra Foods, Cadbury and Schweppes. In 2010 Kraft Food acquired Cadbury bring the joint of two food

France

France is the European largest agricultural producer. The country owns about one-third of total agricultural land in the E.U. Agriculture and food sector plays a significant role in France's economy. The sector contributes about 15 percent of the total manufacturing value added. In terms of food processing products, France is the second largest producer in the world behind the United States. The France FPI has developed to be a modern, highly competitive and innovative industry. More than 1,500 new products launched every year. The product's development strategy aimed at producing products that are easy to use, superior packaging quality, healthy and handy. In 2007, the sales value shows an increasing trend of 7 percent (French Food News, 2009).

There are about 13,000 food establishments in France, and more than 70 percent are SMEs. These establishments provide job for over 420,000 workers. Among the big players of the food industry in France are Dannone, Lactalis, Bongrain, Pernod Ricard, and Terrena. The key to the achievement of this sector lies on research and innovation. Food and beverage companies allocate at an average of 7 percent of their sales to funding innovation. The success story of FPI in France gives impetus for further usage of modern technology in the area of industrial engineering. In the early 1960s, many food industries in France adopted scientific innovations especially in chemistry and biotechnology disciplines. As a result, France managed to bring itself up to the pinnacle of technological advancement of the food industry (Nefusi, 1990).

China

China is a vast market with more than 1.325 billion people live in the country. With that many people living in one country alone, undoubtedly there would be a colossal demand for processed foods. Food industry giants like Nestle, Unilever, Kraft, Continental, McDonald’s, Coca-Cola, Pepsi, Budweiser, and Carlsberg flocked into this country in order to tap into this enormous market. The migration of food industry leading multinationals attracted up to USD 307.3 billion of FDI into China (Wei and Cahco, 2001). Companies like President (Taiwan), Charoen Pokphand (Thailand), Sinar Mas (Indonesia) and Kerry (Malaysia) are among regional investors that took part in China's FPI. The main strategy of the multinationals companies is by forming alliances with local firms and uses the local firms’ advantages to penetrate into the Chinese domestic market.

Standard of living in mainland China is on the climb. As a result, consumers in China are better educated, deliberate and discerning about products than ever before. There are a lot of positive perceptions about foreign brands. Foreign brands regarded by many of having the highest of quality, and would brought new lifestyle to them. Whereas, domestic brands represent outdated tastes; incognizant of the new and modern lifestyle. Hence, it is an enthralling phenomenon to study the interaction between the foreign investors and local firms in China. The multinational brands will remain in the high-end market while the domestic players adopt foreign technology and management to upgrade their operations and produce better products. However, over time some multinationals created the economies of scale and localized their operations. They stepped down from the high-end market and joined the competition in the middle or mass-market.

China’s food sector accounted for USD 104.8 billion in the first seven months of 2004. It constitutes about 10 percent of total industry value and records a remarkable growth of 26 percent. However, this impressive growth is still unable to reduce the influx of the food import into the country. Food import had risen to as much as 50 percent in 2004 to reach USD 11.47 billion; compare to 7.7 percent growth in export value at USD 10.7 billion (Wenzhe, 2004).

India

India is the third largest agricultural producer in the world. The country has enormous number of consumers with populations stood at more than 1.14 billion people in 2008 and increasing. India FPI sector though, still in the nascent stage, constitutes only 14 percent of manufacturing GDP. The FPI sector provides direct employment for more than 13 million people. The sector has the likelihood to promote 2.4 times more indirect jobs for every direct job created. In the FPI, employment over value added is larger as compared to the manufacturing sector as a whole.

Over the last decade, the food processing business in this country grew at a healthy rate of 7.1 percent per annum. This growth is better than the growth for the agriculture sector. The strong growth in FPI is indicative of its low base, increasing availability of surpluses, changing of life styles and tastes, and increasing disposable income of consumers. The area of coverage for FPI in India includes grain milling, milk, meat, poultry, fish confectionary, bakery, convenience foods, fruit and vegetable processing sectors, aerated drinks, beer and non-molasses based alcoholic drink (Ali et al., 2007). India is one of the leading producers of agricultural and livestock commodities. However, the portion of these commodities going for processing is low. Furthermore, India's contribution in the world trade of processed food is a modest 1.6 percent and value addition is 20 percent (India Ministry of Food Processing, Annual Report 2006).

Australia

Australia stands as the world's 14th largest food exporter in the world. In 2008, the export value of processed food stood at $23.4 billion; this represents a contribution of 13 percent of Australia's merchandise exports. This amount also accounts for 1.8 percent of world food exports. This country persisted in being a net exporter of food in evidence with an export surplus of $14 billion over food imports in 2007-2008 (Australia Food Statistics, 2008). Local producers supply almost 97 percent of domestic demand of fruits and vegetables; they also export two-thirds of the produces. Kidane (2005) conducted a study of trading of food processing in

Australia; counted the share of FPI's export to be 68 percent of the total export food value and 20 percent of the total real merchandise value. In essence, FPI is gaining importance to the Australia economy in terms of export earning. The US of America and Asian countries are among the main destinations of food export.

However, during recent years the export rate shows a declining trend which can be attributed to the impact of demand fluctuation in Asian market and health issues, especially severe acute respiratory syndrome (SARS). Ratnatunga (1995) studied on the impact of structural factors on the performance of the Australian food processing industry; found that the liberalization increases competitiveness of Australian food industries. He also reported that Australia's FPI does not seem to have performed satisfactorily. He also noted that both the output and export growth has been sluggish, and competitiveness against imports is weak. During 1978-1989, the output of food processing industry grew slowly, at a meager average of 1.0 percent per annum.

Since the mid-1980s, Australian manufacturing sector has undergone significant changes due to the substantial tariff reductions (Mahmood, 2008). More liberalization policy such as deregulation of financial and foreign exchange markets have also thrust food industry to operate in a highly competitive environment market. An increasingly open economic environment creates this competitive pressure on the food industry market. In 2005-2006, the industry's total sales stood at $71.4 billion and value added at $17.5 billion. As Australia's largest manufacturing industry, food and beverage sector provided more than 17 percent of industry value added and 20 percent of total sales and services revenue. The sector consistently accounts for around 18 percent of Australian employment. Industrial value added per employee in real terms for the broad food manufacturing industry remained above $96,000. In 2005-2006, however, real industrial value added per employee fell by almost 4 percent to $93,300 (Australian Food Statistic, 2008).

Food processing industry in countries like Argentina, Brazil, Malaysia, Thailand, Indonesia and Taiwan are responsible for 40 percent of total processed food exports by all developing countries. It is also evidence that the number of developing countries participating in such exports continues to grow. Countries with superior export record such as Chile, Indonesia, Turkey, Tunisia, Guatemala, El Salvador and Sri Lanka have also been notable in the increase of processed food in their share of non-manufactured exports (Wilkinson, 2004)

2.3 Food Processing Industry in the Malaysia

Malaysia is one of the fastest growing consumer markets in the Southeast Asia region. The population from middle to upper-income groups makes up about 61 percent of these consumers. During 2000-2008, the country showed an impressive and consistent economic growth at an average of 6.7 percent per annum. Currently, Malaysia is the 18th largest exporter nation in the world with a total trade value of more than RM 1 trillion in 2006 and increased as much as 10.5 percent in 2007.

Export during this period expanded by 1.1 percent to RM 283 billion, while total imports value of RM 239.47 billion, an increased about 3.5 percent (MIDA, 2007).

Swift changes in the global economic environment have prompted the Malaysian government to transform its economic development strategy from input-driven to productivity-driven growth. This new strategy gives emphasis on higher quality of inputs to generate more outputs rather than more quantity of inputs through efficiency. Productivity-driven growth is normally attributed to education and training, research and development (R&D), implementation of productivity and quality management systems, adopting new technology, strengthening innovative capacity and protecting intellectual property rights as well as intensifying the usage of information and communication technology (NPC, 2007). Significant growth can be seen from the increase in the total establishment of food industry from 3141 in 2000 to 4682 in 2006; the value added also increase from RM 7,333,798 million in 2000 to RM 11,088,958 million in 2006 (Department of Statistics, 2008).

In the Third Industrial Master Plan (2006-2020), the Malaysian government has promoted the growth of agriculture and agro-based industry as an engine of the country's economic growth. It outlines the strategies adopted to develop the agriculture and the food processing industry in the country. The development of the food industry encompasses all aspects of the production life cycle ranging from ingredients selection, processing, packaging and, marketing of the food products. Malaysian government through its agencies provides assistance to small and medium enterprises especially in the agro-based sector. This assistance includes credit scheme, technological innovation and management skills.

The Malaysian FPI plays a pivotal role to the country's economy by producing several import substitution of food products and, generating job and income for the people. The Malaysian FPI contributes about 10 percent from the total manufacturing output and provides 155,000 employments. The Malaysian food processing industry comprises 97 percent small and medium enterprises and 3 percent large enterprises. Table 2.2 presents five top sub-industries of the SMEs in terms of number of establishments.

Table 2.2 Five Sub Industries with Larger Number of Establishment in the Malaysian Food Processing Industry

Sub Industry	Number of Establishment
Manufacturing of bread, cake and bakery	1132
Manufacturing of other food category	361
Manufacturing of crude palms oil	344
Manufacturing of snack and chips	323
Processing and preserving fish and fish products	262

Source: Department of Statistics Malaysia (2008)

National Productivity Corporation (NPC, 2008) reported that during 1987 up to 2007 food processing industry in Malaysia has average productivity growth of 10.4 percent, value added growth of 16.6 percent, labor cost growth of 4.9 percent and value added contribution to the GDP has growth progress of 3.5 percent per annum (Table 2.3).

Table 2.3 Performance of the Malaysian Food Processing Industry, 1998-2007

Performance	**Percentage growth**
Productivity growth	10.4
Value added growth	16.6
Growth in labor cost/worker	4.9
Contribution to total Manufacturing Value added	3.5

Sources: NPC, 2008

Researchers have conducted several studies on the productivity and efficiency of the Malaysian manufacturing sector in the past. For instance, studies by Ismail and Jajri (2000), Mahadevan (2002), Isa (2005), and Ghani (2004) all conducted to address the manufacturing sector in general and place the food processing industry under a sub-sector. However , the study conducted by Kalirajan and Tse (1989) and Alias Radam (2007) specifically addressed the Malaysian food industry.

The last decades saw the contribution of Malaysian manufacturing output to GDP grew from about 19.3 percent in 1979 to 34.2 percent in 1996. The total factor productivity (TFP) growth of the manufacturing industries can be used as an indication of the sustainability growth of the industry in the long run. However, many external problems faced by all industrial sectors such as the energy crisis and the fluctuation of output and input factor price. Tight competition in the global market has forced the companies to increase their competitiveness.

2.4 Structure of the Malaysian Food Processing Industry

Food processing in Malaysia comprises manufacturing sector classified under codes 151 through to 155 of the MISC (Malaysian Standard Industrial Classification). This is a new classification codes used since 2000. Previously, codes 131 through to 135 of the MISC were the classification codes for the food industry. In this study, there are 35 sub-industries categorized as small and medium scale enterprises (SMEs) and 27 sub-industries as large-scale enterprises (LSEs). In 2006, there were 4,682 establishments involved in the Malaysian food processing industry. About 97 percent of these establishments are small and medium enterprises. The discussion on the detail of each sub-industry is presented in chapter five.

The SMEs in general have limited resources and capabilities; short in financing; inadequate strategy in marketing; and mainly serve for the domestic market. Innovation is almost nonexistence. These companies used innovation developed by public research institutes for their product development and production process improvements. The largest sub-industries in the SMEs in term of value added are sub-industries palm oil, refined palm oil, animal feed, sugar and processed fish and other fish by-products.

The LSEs, on the other hand, typically have their own established brands with fully equipped in-house research and development (R&D) facilities to support the sustainability of the brands. The LSEs also possess greater financial resources than their lesser counterpart, which enables them to apply advanced technology in their daily operation. Most of the products produced by the LSEs are mainly for export market and local up-market. Malaysia has an open economics environment that encourages the import-export activities for the FPI. The year 2015 will mark a momentous occasion for all ASEAN member countries as they will sign a treaty for ASEAN Free Trade Agreement (AFTA). This treaty will fuel further challenge to the food industries in the region.

2.4.1 Small and Medium Enterprises of the Malaysian FPI

Many economic researches done in the past have established the fact that the Small and Medium Enterprises (SMEs) are dynamic agents of economic growth. Henceforth, many nations in the world have adopted various support programs for the SMEs (Taymaz, 2005). The SMEs play a significant role in economic growth for both the developed and developing countries. For instance, in Japan the SMEs form about 99.7 percent from the total number of businesses (4,690,000 enterprises), contribute 70.2 percent in the employment sector and 51 percent share in the shipment value (Anonymous, 2007). Woods and Dennis (2009) noted, in the United Kingdom the share of the SMEs was 92 percent from the total number of establishments (1.2 million out of 1.3 million total establishments). Other researchers such as Massey et al, (2007) in New Zealand; Man and Lau (2005) in Hong Kong; Simon and Durkin (2007) explain that the SMEs play a decisive role to the nation's economy. According to Ricketts and Rawlins (2001), small and medium enterprises in the U.S. created 1.5 million jobs in 1992 and 1993, in contrast to the large-scale enterprises which lost 4.1 million jobs. The SMEs accounted for 97 percent from the total number of establishments, and they share about 40 percent to the nation GDP.

In the context of Malaysian manufacturing sector, the scale of an enterprise can be defined as micro, small or medium based on the number of employee the company employed or by its annual turnover sales. The SME involved in the food processing, or agro-based industry is an enterprise with full-time employees not more than 150 people, or with an annual turnover not exceeding RM25 million (SMEs Corp, 2009). The definition extends to include micro enterprise (five employees or less with annual turnover not more than RM250 000), small enterprise (5-50 employees with annual turnover RM250 000 – RM10 million) and medium-scale enterprise 51-150 employee with annual turnover RM10 million - RM25 million).

The SMEs form a vital income sources for many people in the urban and rural areas alike. Farmers, intermediaries and suppliers of large enterprises benefited directly from these companies. This group of companies also stands as an integral part of the economic sector which provides value added to the overall production network. The role of these companies includes downstream suppliers supporting the large-scale enterprises and the end-consumers by providing intermediate goods and services. In terms of job creation, the SMEs yield about two third of labor forces in the country. In 1996, the Malaysia government acknowledged the importance of the SMEs to its economy by establishing the Small Medium Industries Development Corporation (SMIDEC) to provide an effective planning and development programs. Recently, SMIDEC has changed its name to the SME Corporation.

In the Ninth Malaysian Plan (2006-2010), the Malaysian government signaled its strong support to the SMEs by providing technical, innovation, market access, managerial training and financial scheme to strengthen its performance. The Malaysian government introduced as many as 245 programs involving financial commitment of RM3.9 billion, to provide the infrastructure needed to build the capacity and capability of SMEs in 2006. There are 42 key-programs implemented to strengthen the infrastructure to support the SME development, 33 key-programs for greater access to financing, and the establishment of a RM300 million venture capital fund for agriculture. The government also allocated an additional of RM300 million for the Fund for Food program (SME Corp, 2009).

The crucial challenge for the SMEs food industry was keeping the supply of the raw materials. Domestic production of some agricultural commodities in Malaysia is less than the domestic demand (consumers and processing industry) especially meat, dairy, rice, sugar and cocoa bean. Consequently, Malaysians' food industries depend heavily on imported raw materials. For example, in the chocolate industry where

Malaysia is currently the fourth largest producer in the world but more than 70 percent of the cocoa beans are mainly imported from Indonesia.

2.4.2 Large Scale Enterprises of the Malaysian FPI

Though, the number of establishments of the large-scale enterprises (LSEs) is only around 3 percent, but its contribution to the total FPI's output is around 48 percent. The LSE is usually characterized by employing modern technology in its operation, being capital intensive and having huge allocation for R&D. It was not all sub-industries in the Malaysia FPI attract the large investor. The sub-industries of peanut and peanut products, tea, glucose, syrup, maltose, sago and tapioca and other starch products, coconut oil, rice, flour products and ice have not been included in the LSEs list. Recently, large-scale enterprises of food industries each competed in the domestic, regional and international market. Henderson (1998) argues that competitiveness is strongly influenced by the intensity with which firms use intellectual inputs such as patents, brand names, product reputation, trademarks, trade secrets, suppliers and consumer loyalty, and advanced technology.

2.5 Export and Import of Food Products

Food distribution in the international market is geared by the theory of comparative advantage. Country A may produce a commodity cheaper than country B, but country B can produce cheaper for other products than A. In the food distribution system;

high technology country usually imports a raw material from a lower technology country and sells it as more valuable products.

The impressive growth of the Malaysian manufacturing sector is associated to the successful of government’s strategy to promote expanding export of higher value added goods. This success is also getting the benefit from the country's location in the central of Southeast Asia to compete in the region market. The location has an advantage because the neighbor countries like Indonesia, Thailand and Vietnam, which produce raw material for the Malaysia industrial sector.

Table 2.4 shows the trend of export and import of selected major food trade in Malaysia during 2000-2010. The larger average growth of the export items was found in the fruits as much as 174 percent and meat and meat product of 165 percent during 2000-2010. While the larger growth of import found in the commodities of meat, other food products and animal feed of 28 percent, 54 percent and 49 percent respectively. Negative growth of import was found in the commodity of vegetable, cereal, live animal and fish products. Below, we discuss several major food industries in Malaysia. The major items of imported food to this country are dairy products, sugar and sugar confectionery, processed meat and processed seafood. , the major exports from Malaysia are fish and fish products, fruits and cereal products.

Tabel 2.4 Major Food Export and Import in Malaysia

	EXPORT (RM mil)			IMPORT (RM mil)		
	2000	2005	2010*	2000	2005	2010*
Live animal	357.4	425.1	467.0	154.6	177.4	127.0
Meat & preparation	64.6	85.9	2895.0	771.4	1054.6	1262.0
Dairy Products	410.2	413.2	520.0	1176.5	1745.1	1533.0
Vegetables	278.4	491.6	614.0	1023.6	1620.2	670.0
Fruits	512.4	471.9	2153.2	561.6	694.9	812.1
Sugar and Preparation	353.7	479.2	474.6	1085.2	1406.0	1216.0
Cereals	610.8	916.6	576.5	1839.1	2267.1	1464.8
Fish products	1263.3	2265.9	4624.7	10851.9	1851.9	841.0
Animal feed	375.3	547.1	531.0	1928.4	2838.2	4303.0
Others	1042.5	1890.3	2645.0	917.3	1779.6	2048.0

Sources: The Department of Statistics, Malaysia Plan (various issues), (*) is estimation value.

Meat and meat product preparation

At present, more than 52 companies in Malaysia involved in the meat processing industry. Senik (1995) identified that the major producers in this sub industry are manufacture of sausages, canned chicken and canned pork, which is supplied mostly for foreign market. In small-scale processing, meat is made into various traditional food products such as meat floss, dried curried or spiced meats, and meatballs. Especially in the livestock sub-sector, Malaysia was success to stands up as the third largest producer of poultry and poultry products in the Asia Pacific region. Malaysia is self-sufficient for in poultry, pork and eggs, but about 80 percent of demand for beef is still depending on import sources (MIDA,2007).

Dairy Products

Mostly, dairy processing plants depend on imported raw material. Although domestic farming is also producing fresh milk, but 90 percent of the raw material for the milk processing industry is supplied by foreign sources. There are three main dairy products in the Malaysian dairy market: liquid milk (fresh milk, pastured/ evaporated and ultra-high temperature), milk powder (including butter, cheese and yoghurt) and ice-cream. Advanced knowledge about health food has increased demand for dairy products such as yoghurt and goat milk.

Considering the increasing demand on milk and milk products, dairy farming has grown to become an important and fast escalating industry. Typically, the milk producers are owned by small holder farmers. However large scale enterprises have also invested in the dairy processing sector. The main the operators in the Malaysian dairy industry are Nestlé (Malaysia) Berhad, Malaysia Dairy Industries, New Zealand Milk, Dutch Lady Milk Industries Berhad, Fraser & Neave Holdings Berhad and East Asiatic Company.

In order to support domestic production, Malaysia Government gives incentives to local producers, which mainly allocated to the fresh milk farm. The dominant policy was that of input subsidies to the smallholder cattle milk and subsidization of the development and operating expenditures of the farmer. While the Veterinary Department supports under various programs such as cattle breeding, artificial insemination services, disease control program, and subsidies given to milk collection centers (Wells, 2007).

Fruits and Vegetable

Many different kinds of fruits and vegetable are grown in Malaysia, mostly by the small scale farm. However, the larger demands of Malaysian consumers were unable to be supplied by the domestic production. Therefore, import source should fill the demand gap. Thailand, Australia and China are the major import sources of fruits to Malaysia. Tey et al. (2008) analyzed demand for vegetable in Malaysia found that the demands increase when per capita income rises.

Several kinds of the fruits and vegetable are processed mostly to be a ready product or intermediate products such as tomato, chili, peanuts and cassava. Under supervision of Agricultural Ministry, a few commercial farms have started to produce growing fame fruits such as banana, guava, papaya and star fruit on a larger scale, both for local consumption and for the export market. Pineapple is generally processed into canned products such as a juice, syrup, jelly, jam and pineapple cube (Senik, 1995; Tey et al., 2008)

Cocoa products and Chocolate Industry

Cocoa was the third major agro base industrial commodity after crude palm oil and natural rubber. As many as 120,000 family farmers involve in the cocoa farm and absorb 36,000 employments. Until 1990s Malaysia was ranked at 6th the largest cocoa bean producer in the world beneath Cote d'Ivore, Ghana, Indonesia, Brazil and Nigeria. The third National Agricultural Policy (1998-2010) reports that export volume reaches 116,400 tones share as much as 4 percent of world production in 1995. Since 1990 due to a fluctuation of cocoa bean price in the global market, farmer change to grow other commodities and the cultivated land decrease up to 37 percent mainly in Sabah and Sarawak. Value export also decrease from RM 756 million in 1990 to be RM 625 million in 1995. However, the export of higher value cocoa products such as cocoa powder, cocoa paste and cocoa fat shows an increasing trend. There are 10 cocoa manufacturing in Malaysia produce 125,000 tones processed cocoa products. Currently, portrait of the Malaysian cocoa industry is facing some challenge factors such as shortage of raw material, global competition, tariff and non-tariff barrier, shortage labor, low productivity and technology. Malaysian Cocoa Board (MCB, 2008) reported total farm of cocoa in Malaysia has decreased of 29 percent from 28,154 ha in 2007 to be 19,976 ha in 2008 and total production decreased of 20 percent during the same period. This condition brings the cocoa processing industry dependent on imported raw material. Although the raw material imported from abroad, investment in this sub industry is still attractive due to huge global market of cocoa and chocolate products.

CHAPTER 3

LITERATURE REVIEW

This chapter presents a review and discussion about the concept of productivity and efficiency analysis in industry emphasizing on the Food Processing Industry (FPI). Primarily, the review laid down the discussion on two main issues. Firstly, the discussion is about productivity, including theory of productivity, productivity growth and efficiency in the FPI. Secondly, it focuses on the methodology that the study employs to analyze the productivity and efficiency. The consecutive sections of the chapter: introduction, concept of efficiency, concept of productivity, productivity in the manufacturing sector and food industry, determinants of productivity growth and concept of productivity measurement.

3.1 Introduction

Productivity growth has a close association with development of a nation because it depicts the performance of economic sector and development as a whole (Villar, 2003). Nowadays, there are growing concern among practitioners and researchers about productivity. Low productivity indicates that inefficiency exists in the production process. This condition can be viewed from an amount of input to produce output or from amount of output produced by using a fixed amount of input for a period of time. High productivity means that the operation of an organization is on the right track in achieving its goal. Therefore, understanding the variations of productivity and the driving factors behind it is a crucial issue.

For long-term effects, improvement of organization’s performance and competitiveness should be based solely on the productivity growth. High productivity means better technical performance and allows lower prices to be charged for certain products (Bleischwitz, 2001). Lower prices offered competitive advantages and increased market shares, hence meeting most of organization’s goal and gratifying the stakeholders’ interests. However, during the preliminary stage of the productivity improvement process, the organization’s may suffer the revenue decreasing. As an example, if the budget for staffs' training or expenditure for R&D increases, then it would shrink the profit margin a little. In the long term, however, highly-skilled labor or an innovation can produce more output and increase the profit.

Islam (2008) expressed that most of the studies about productivity, in the past, focused on a single underlying variable as determinants such as size of a company, social infrastructure and ownership. Therefore, it is difficult to ascertain whether the inclusion of a wider set of determinants in the study will produce accurate results. Managers, engineers, and social scientists are among those who have a keen interest in analyzing the method of measuring productivity. Misterek et al. (1992) said that the most salient characteristic of productivity measures was its ability to unravel factors, which affect the productivity. Yu (1998) noted that most of the studies about efficiency measurement only interested in measuring the 'observed' efficiency performance of the firms. Those studies paid little attention to the interpretation of the efficiency measures.

3.2 Concept of Efficiency

Many literatures in the operational research gave a perspective on efficiency as proper utilization of firms' resources. Zahid and Mokhtar (2007) argued that efficiency is crucial in indicating and benchmarking the relative performance of firms’ business operations. First generation of researchers in modern efficiency measurement such as Debreu (1951), Koopmans (1951), Farrell (1957) defined efficiency as the ratio of minimum potential input to the actual input at a given level of output and technology. The closer the actual input to its potential minimum means a greater efficiency indicated by the value of the ratio which is closer to unity. Another definition views an efficient firm as one which produces the optimal quantities of output at a given quantity of inputs at a certain level of technology. The former definition is conditional upon the view of input oriented measurement and, the latter is conditional upon the view of output oriented (Dimara et al., 2008). Sengupta (2005) argued, in slightly different words, an observed firm considered efficient, if and only if, the improvement of its inputs or outputs exacerbated some of its other inputs or outputs.

In the realm of managerial planning and decision making, the relationship between efficiency and effectiveness is crucial. Though efficiency rate is high when measured, but it is incongruent to the objectives; therefore, it can be deemed ineffective. Fundamentally, productivity and efficiency can be used interchangeably (Sudit, 1984). Farrell (1957) proposed, theoretically, efficiency consists of two components namely technical efficiency and allocative efficiency.

Technical efficiency reflects on how close a firm to producing maximum output from a given level of input. Allocative efficiency reflects on the ability of a firm to utilize the input in an optimal proportion at a given price and technology.

3.3 Concept of Productivity

Productivity is a key performance indicator for an organization. Any organization, regardless of manufacturing or services, need to measure, evaluate, and improve their productivity (Sumanth and Yafuz, 1983). Sudit (1984) concluded that productivity is a significant indicator for industrial enterprises to have sustainable growth and stable profitability in a competitive environment.

The basic concept of productivity, which rather extensively used, is the ratio of output to input. In the situation where production comprises solitary input and output, the measurement process is rather straightforward, but it becomes complicated when production entails many inputs and outputs. Fukuda and Sase (1994) suggested that production output could be measured as total shipment of products or services; or sometimes stated in value of sales, value added, profit or value of gross output. Definition of input stated that “the inputs are everything that goes into a production system, which contributes directly or indirectly, to produce outputs and the outputs are everything resulted from the production system”.

There were many definitions of productivity that came to light over the years. These definitions varied across the industries, which had differences in their objectives and perspectives. The divergence of views and understandings of productivity among economists, engineers, scientists and policy makers were due to disparities in the objectives, methodology and focus of their discussion. Pritchard and Roth (1991) pointed out that existing definitions can be classified into three main categories. The first category defines productivity as an efficiency measurement which can be defined by the ratio of output over input and can also be expressed in a currency value. The second category defines productivity as a combination of efficiency (output/input) and effectiveness (output/goal) - not only measure the value of output but also objective. The third category defines productivity as anything that makes the organizations operating well. The word “anything” may include efficiency, effectiveness and other intangible inputs like morale, social benefit and innovation.

In the traditional framework, there are two main approaches in the study of productivity, namely partial productivity and total productivity (Heshmati, 2003; Hoque and Falk, 2000). Before 1940s, partial productivity analysis was popular due to its uncomplicated measurement techniques and easy interpretability. Currently, partial productivity is still in use, mainly, by practitioners to benchmark the productivity level of the input factors among firms or industries. It depicts the contribution of an input to the output while ignoring other input’s contribution. Disadvantage of the partial productivity is its inability to give satisfactory answers in the analyses of relationship between productivity and multiple inputs.

Limitations inherent in the partial productivity analysis led researchers to develop more comprehensive productivity measurement tool, which encompass all productions' inputs and outputs. This new analysis tool became known as total productivity measurement. Total productivity explicates the combination impact of the entire inputs to the total output in the production process. It gives an explanation on the magnitude of changes in company's output as a direct result of changes made to the inputs such as labor, capital, and materials (Mady, 1992). Impressive growth cannot be sustained for a long period without continuous improvements in productivity. Hence all organizations need to operate at the optimum level with appropriate allocation of resources to achieve their goals and stay competitive in the global market (Pritchard, 1995).

Smith (1973) proposed a productivity measurement as a system approach in the context of an agreement. Agreement gives impacts to the productivity through the efficiency of labor input factor. Both employee and company more focus to attain a target by stipulate it on an agreement. Other researcher Fukuda and Sase (1994) introduced productivity measurement from management's standpoint, which they named integrated productivity quality improvement (IPQI). This productivity approach based on the production process management, which holds characteristic such as its process-oriented, bottom-up decision making and flexible job assignment.

3.3.1 Partial Productivity

Commonly, the three input factors used for partial productivity analysis are labor, capital and material. Traditional approach of productivity measurement mostly based on the model with these three factor inputs included. For agricultural farming, land is a crucial input to be included in the model. Labor productivity is a key factor and it is widely used as a pointer in the economic and statistical analysis. At the firm level, labor productivity is an essential factor to be analyzed as labor cost represents a substantial percentage in the total cost (Freeman, 2008). The public, through media publicity, are more familiar with the labor productivity measurements due to its straightforward calculation and easy interpretability.

In contrast, Smith (1973) argued that, at the industry level, labor productivity was rather difficult to be defined because of its relationship with output is obscured by other factors. Increased in labor productivity may not reflect the actual utilization of labor in that industry, but it could reflect the productivity of other inputs. The theory of the macro economy stated that the relationship between labor productivity and welfare known as an ambiguous cycle relationship. The improvement in the productivity can be achieved by reducing the percentage labor utilization, but at the same time producing the same level of outputs. On the other hand, higher productivity brings other impact such as lowering of the output’s price and, thus, increasing the demand. As a result, a firm needs to employ more people to cater for the increase in the production.

Empirical research about partial productivity in the manufacturing sector has been widely reported in the literature. For instance, Ismail and Jajri (2000) studied on LSE in Malaysia; they assessed the labor productivity growth using OLS method and calculated the contribution of physical inputs and efficiency to the labor productivity growth rate. In this case, labor productivity measured as the ratio of the total value added of each sub-sector to number of labors.

In the U.S. industrial sector, Holman et al. (2008) identified the sectors: information, manufacturing and retail are the sectors that have higher labor productivity. Mining and food services are the sectors that have lower labor productivity. During the period of 2000-2005, labor productivity increased as high as three percent per annum. Most of the sectors had weak output growth, yet continued to improve efficiency and maintained productivity growth.

Mahmood (2008) investigated labor productivity of SMEs in Australia during the period of 1994-2000. In the study, he reported that there was a significant, independent effect of labor productivity to the business cycle. Labor productivity of SMEs varies among each sub-sector; food, beverage and tobacco showing lower labor productivity than other sectors. However, the study could not establish any definite relationship between labor productivity growth and employment. Mok (2002) noted that one key variable affecting productivity was the proportion of temporary workers in the total labor force. The flexible use of temporary workers could produce a positive effect on enterprise productivity.

Besides the partial productivity, there are other productivity measurements such as the one in operational management study called capital productivity. Morrison (1997) analyzed capital productivity in the US food processing industry and concluded that rapid investment in high technology observed in the food processing industry was a clear motivation for cost savings. One of the sources of capital in the industry is foreign direct investment (FDI). In Malaysian's food industry, multinational-food industries ventured into this country and setup a joint-operation with local firms to process, pack and market local raw materials under their brand (Khalifah and Adam, 2009). Many local firms benefited from capital and technology spillover brought about by the foreign direct investment into the country. These firms also enjoyed an increase in the capital productivity.

About 60 percents of production cost in food processing industry go to purchasing of raw materials; the other 30 percents go to energy bills and the remaining 10 percents for labor and other miscellaneous cost. Hence, it is vital to know the material productivity since a significant proportion of production cost is in the raw materials. Adelaja (2000) investigated the productivity growth and input mix changes of New Jersey food processing found that material productivity growth is probably more relevant than labor productivity growth, and higher efficiency of materials are likely to have a greater effect on total factor productivity growth than do gains in labor efficiency.

3.3.2 Total Factor Productivity

The original concept of total factor productivity was the collective work of Kendrick (1956), Solow (1957), Griliches and Jorgenson (1966), Denison (1969), see Dogramaci (1983). Productivity growth depicts a firm's ability to allocate intelligently the limited inputs such as labor, capital, material and energy resources that would encourage the development of the economy.

One of the total factor productivity models, which attract many debates and discussions, in the literature is the model developed by Robert M. Solow, (Solow, 1957). The idea arises from a question, why does the disparity of economic growth among countries in the world exist? Solow developed a total factor productivity analysis with the variables like labor, capital and technology included in his models. The productivity analysis model focused on the unexplained part of the growth of the economy, namely residual component. After this period, subsequent studies on total productivity widely published in many economic fields.

The concept of productivity measurement explicitly spawned from a production function, which measures the contribution of factor input to generate output. Total productivity is fairly uncomplicated, but it is difficult to put into practice due to different outputs (goods and services), and inputs (labor, material, capital and energy). Two components of the total factor productivity are technological change and technical efficiency (Coelli et al., 2003). A positive (negative) technological change will increases (decrease) productivity by shifting the production function. While technical efficiency influences productivity along the production function.

Study about total factor productivity conducted by Kendrick (1956) and Denison (1969) using the Laspeyres index or index number which based on the price of the input. Economic theory of the index number can be defined as the ratio of the index number for output to input by a production function. Afriat, Diewert, Samuelson and Swamy, made significant contributions for the development of this method (see Christensen, 1975). These researchers defined total factor productivity as an index of total output divided by an index of total input. In other words, it is a generalization of concept in partial factor productivity. The use of index number as a concept of total productivity measurement had been widely accepted since half a century ago.

Diewert (1976) was the first person to introduce a superlative index number. In principle, this concept measures price index of total output and price index of total input, which is also known as a price index number. This index based on period weighting schemes, and could be written as:

$$\frac{X_1}{X_0} = \sum p_{i0} X_{i1} / \sum p_{i0} X_{i0} = \sum w_{i0} (X_{i1} / X_{i0}), \quad \text{where}$$

$$W_{i0} = p_{io} / X_{i0} / \sum p_{j0} X_{j0} \,.$$

Subscript 0 represents the base period, and subscript 1 represents the comparison period. In this concept, price in the base period assumed to be constant. Therefore, the index could show the change in value of total input, which resulted from pure quantity change. This weighted price index was constant to a preselected base year level.

During its development, divisia index is preferable to the price index number because it defined a continuous time by the integral line. The divisia index referred by Solow (1957) that, under a certain circumstance, it is the natural way to indexing a technical change. Furthermore, divisia index was extensively employed in the productivity measurement (Hulten, 1973). Following the work of Fisher (1972), as he formulated the divisia index by forming a log change index:

$$\log \frac{X_1}{X_0} = \sum \bar{W}_i \log(X_{i1} / X_{i0})$$

Where $\bar{W} = (W_{i1} + W_{i0}) / 2$

This index recommended for application by Tornqvist, and widely used by many researchers. Price index is accurate for linear production function and holds the price fixed at the base period. Tornqvist is accurate for homogeneous translog production function and uses price in both periods (i.e., base and comparison).

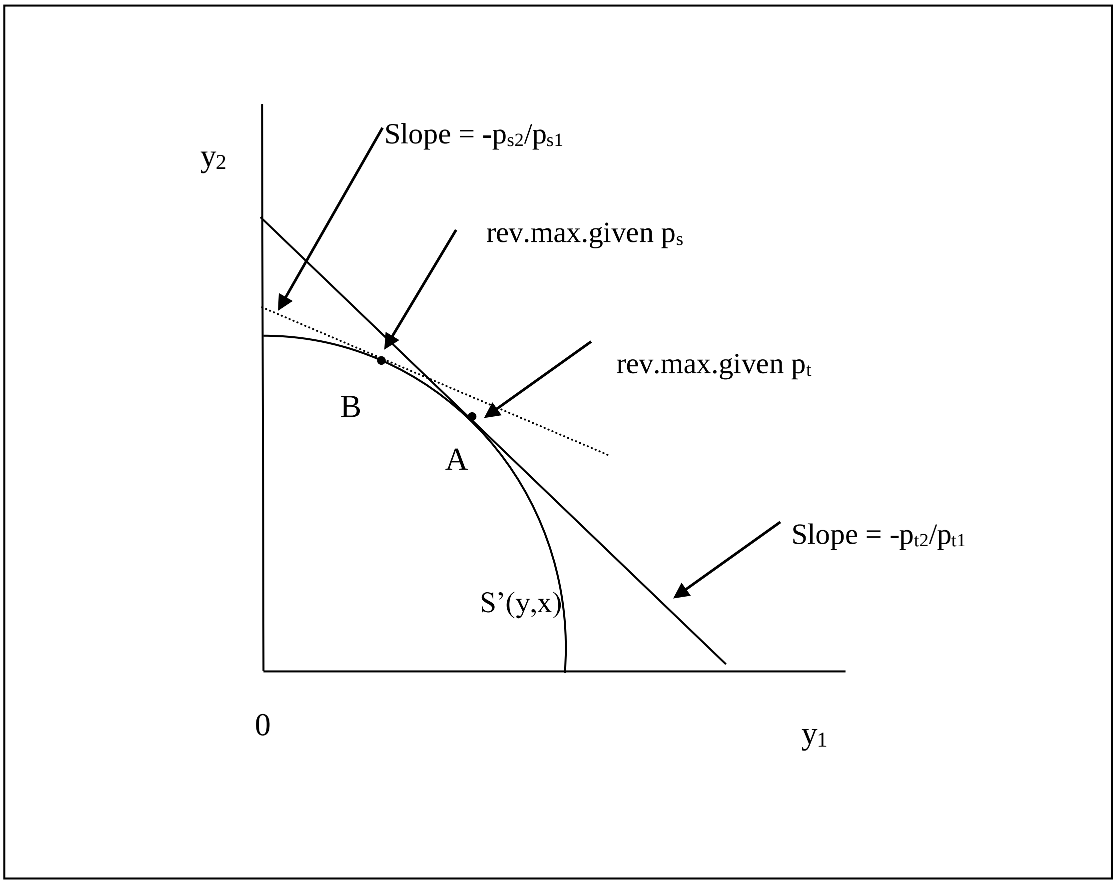
However, inconsistent with Tornqvist's idea, Caves et al. (1982) argued that index number is not convenience to measure actual productivity, because it needs comparison using continuous data point. There are two natural approaches to measures the productivity differences: (1) differences in maximum output conditional on a given level of input and (2) differences in the minimum input requirements conditional on a given level of output. Caves et al. (1982) extended the Malmquist deflation idea and further define Malmquist productivity index. Malmquist index is a generalization of the Tornqvist productivity index, originally proposed by Christensen.

The principal assumption in the economic-theoretic approach of the index number is that all observed firms in the period t and t+1 technically and allocatively efficient. It means that the input and output data were the outcome of optimization of production behavior. Coelli et al. (2003) provided an index number formula to measure TFP, which drawn from the work of Fisher and Shell (1972) based on t period technology as below:

$$P_o^t(P_s, P_t, x) = \frac{R^r(p_t, x)}{R^t(p_s, x)}$$

P_o = Price of output *i*, at two time period *s* and *t*

This is a ratio of maximum revenue of two price vector p_s and p_t by using a constant input x. This formula can be shown graphically, and this depicted in the Figures 3.1, which observes the revenue maximum points based on two price vector p_t and p_s.



Source: adopted from Coelli et al. (2003)

Figure 3.1 Concept of Output Price Index

This output index number believed to satisfy a set of functional properties such as monotonicity, linear homogeneity, identity, proportionality, independence of unit measurement transitivity for fixed t and x and time-reversal properties. Refer to the same assumption, (optimization behavior) the output price index bounded by Laspeyres and Paasche indexes:

Laspeyres price index = $\frac{\sum_{i=1}^{M} p_{it} y_{is}}{\sum_{i=1}^{M} p_{is} y_{is}} \le P_o^s(p_s, p_t, x_s)$

Paasche price index = $\frac{\sum_{i=1}^{M} p_{it} y_{it}}{\sum_{i=1}^{M} p_{is} y_{it}} \le P_o^t(p_s, p_t, x_s)$

Both formulas can be explained by using Figure 3.1 above. For example, in Laspeyres price index, the revenue produced at point A must be equal to $\sum_{i=1}^{M} p_{it} y_{is}$ and the revenue produced at point B must be equal to $\sum_{i=1}^{M} p_{is} y_{is}$, which is consistent with the earlier assumption. The revenue generated from *y* vector output and maximum for given p_s. The difference between Laspeyres and Paasche index is that the Laspeyres index uses the base period quantities as weight but Paasche index uses the current period as weight (Coelli et al., 2003).

Hawaleshka and Mohamed (1987) introduced total operational productivity (TOP) and technology factor index (TFI) to administer the productivity improvement process. Five categories of industrial productivity measures: (1) single factor productivity, (2) multi factor productivity, (3) total productivity, (4) managerial control ratio and (5) productivity costing. Single factor productivity designed to measure the ratio of output to one factor of selected input, which is widely known as partial factor productivity. Multifactor productivity measures the ratio of output or value added to labor and capital input. It is highly dependent on the assumption of cost minimization, market competition and scale of return. Multifactor productivity measures productivity using disparate data depending on the objectives. Total productivity can be defined as effects of change of total output relative to the change of all inputs. The managerial control ratio is a network of productivity and its relationship with direct input factors. Productivity costing is a system approach in the measurement of productivity to recognize cost minimization based on the capacity of production. These five basic productivity measurements have their own advantages and disadvantages as illustrated in Table 3.1.

Table 3.1 Advantages and Disadvantages of Five Basics Productivity Measurement

Advantages	Disadvantages
Single factor productivity 1. Measured more easily than other productivity indices. 2. Technological innovation has been acknowledged through the displacement of labor by increasing man-hour SFP. 3. One input forms a relatively large part of the production system inputs. 4. Data relatively available.	1. It does not indicate the productive contribution of the whole production system. 2. Misinterprets the risk of including unrelated shifted output increase due to measurement of a single input only. 3. Can changes as a result of mechanization and automation which are not included in the model. 4. Can be misleading due to labor negotiations.
Multi factor productivity 1. Measures the change in output per unit of combined more than one factor input. 2. Considerably closer to an ideal measure of efficiency and productivity through the use of all resources.	1. Exclusion of some material inputs may ignore some technological improvement due to its value added approach. 2. The production function does not reveal the causes of observed changes 3. Does not specify the variation in relative utilization of capital and labor
Total productivity 1. It is the most inclusive index for measuring the whole production function. 2. Provides the rate of growth (loss) for the whole company.	1. Does not show the interaction between each input and output simultaneously 2. As a tool of improvement it is too broad. 3. Each input factor is considered to be a dependent parameter. This is not always so.
Managerial control ratio 1. Considers the interaction of technology through the profit/investment ratio. 2. Presents a blend of physical and financial aspects of resource flaws for short- and long-term planning.	1. Does not derive the industry productivity ratio. 2. Deals with capital input changes rather than with the whole production system inputs. 3. The percentage changes in each individual financial activity ratio do not necessarily indicate its effects on the overall productivity.
Productivity costing Deals with unit cost of a product and cost ratio investigation.	1. Deals with profit-cost analysis rather than productivity. 2. Clearly demonstrates the effects on the overall system costs of below capacity production which contribute to the prices, but not to productivity. 3. The analysis of managerial cost of each single product is not feasible for a company producing a large number of products.

Sources: adopted from Hawaleskha and Mohamed (1987)

Total operational productivity (TOP) and technology factor index (TFI) concepts developed by Hawaleshka and Mohamed (1987) could be defined as the ratio of total quantified value of shipment to total quantified value of human effort, capital, energy, material and other cost consumed in a given time with constant price. The concept of TOP can be written as:

$$TOP_{it} = \frac{\sum_{k=1}^{K} Y_{itk}}{\sum_{j=1}^{J} X_{itjl}}$$

TOP_{it} = TOP of industry *i* during time *t,*

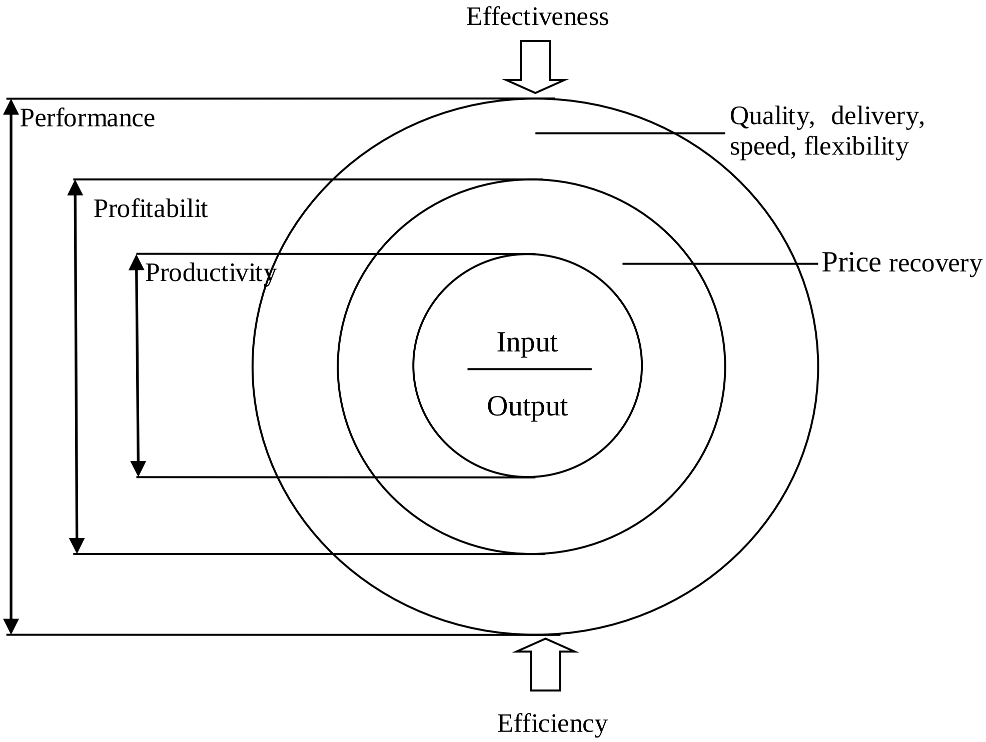
Y_{itk} = amount of output from industry *i* during time *t* for output *k,*

X_{itjl} = amount of input consumed in industry *i* during time *t* for input *j* (human, capital, material and energy).

Total operational productivity index (TOPI) is the ratio between TOP in period t and period t-1: $TOPI_{it} = TOP_{it} / TOP_{it-1}$. Technology factor index (TFI) is constructed from the aggregate change of the productivity theory. The relationship between TOP and TFI can be written as: $TOP_{it} = f(TIF_{it}, \varepsilon_t)$. If the data is linear: $TOP_{it} = a + b\,(TIF_{it}) + \varepsilon_t$, and if the data is non-linearly then $TOP_{it} = ae^{c(TFI_{it}) + \varepsilon t}$. An empirical study applied this model to metal industry in Canada manufacturing sector during 1971 – 1982, found a relationship between TOP and TFI: $TOP_{it} = 1.885119e^{0.661TFI_{i}}$.

Kemppila and Lonnqvist (2003) proposed an alternative tool for productivity measurement namely subjective productivity measurement. The model was a developed based on personnel's subjective assessment, not based on quantitative operational information. This method is still new and, therefore, has excellent potential for future productivity studies; yet, so far there are only a handful of studies published using the method. The theory behind this method is that customarily quantitative data are difficult to obtain from an operation. For instance, works of professional and expert with intensive knowledge of a certain area of expertise are not easy to quantify in terms of its input and output. Subjective productivity measurement depends on qualitative data such as beliefs, perception and attitudes instead of quantitative data from operation of objective productivity measurement.

Tangen (2002) described the relationship between productivity, profitability and performance by forming triple "P" circles as illustrated in Figure 3.2. Productivity is calculated by weighting input and output data at the centre of the circle. Price recovery converts productivity to profitability. In addition to firm's profitability, good management traits such as timely delivery, high-quality products and flexibility would propel a firm to reach the highest level of competitiveness and effectiveness.



(Source: Tangen, 2002)

Figure 3.2 Relationship among Productivity, Profitability and Performance

Over the years, issues on the strengths and weaknesses of productivity measurement method sparked debates among social scientists. For any system, productivity in its simplest expression is what goes into the system and what comes out from it (Misterek et al., 1992). Products, services or information are outputs produced by convertible inputs and durable resources. Conceptually, productivity measurement is a challenging and difficulty process especially for non-quantified variables.

Most firms use traditional cost accounting to evaluate their performance. However, this approach received criticisms from the economists because it created distortion in the product cost and failed to provide management with effective and efficient tool.

Misterek et al. (1992) suggested that firms would experience a healthy productivity growth if they satisfy one of the conditions listed below.

1. Increasing output and input, where the percentage of increase in output is greater than in input; called *managed growth,*
2. Increasing output but no change in the use of input; called *working smarter,*
3. Increasing output but decreasing in the use of input; called *the ideal,*
4. No output change but decreasing the use of input; called *greater efficiency,*
5. Decreasing output and input, where the percentage of decrease in output is smaller than in input, called *management decline*.

Such firms can also experience zero productivity if they fit into one of the following three conditions: (1) no change in both output and input (static condition), (2) output and input increase in the same proportion (static growth) and (3) both output and input decrease in the same proportion (static decline).

A review of the literatures suggested that many of the recent studies on productivity growth placed emphasis on decomposing total factor productivity growth (TFPG) into efficiency and technological components. The disintegration process shifted and aligned the TFPG closer to production function. The breakdown produced several measurements such as technical efficiency change, pure efficiency change, scale efficiency change and technological progress (Leung, 1998; Kim and Han, 2001; Margono and Sharma, 2006; Kumar and Basu, 2008).

Mahadevan (2002) studied the productivity growth of the Malaysia manufacturing sector by employing DEA method to disintegrate the Malmquist index of total factor productivity (TFP) growth into components like technical change, change in technical efficiency and change in scale efficiency. By studying the panel data of 28 industries in the sector from 1981-1996, he established that the Malaysian manufacturing sector had annual TFP growth as much as 0.8 percent. The small gains in both technical change and technical efficiency drove the growth.

3.4 Productivity Measurement in the Food Processing Industry

Similar to productivity measurement in the other economic sectors, productivity in the industrial sector explicitly derived from a production function. Production function defined the relationship between a variation of inputs and a variation of outputs for a given period. Shifting in the production function reflects a change in the productivity. Total factor productivity reflects the combined effects of all input factors, including research and development (R&D), new technologies, managerial skills and changes in an organization of production (Khan, 2008).

In the theory of production economics, there are two methods to increase output: (i) employing more inputs into the production process; or (ii) using current inputs more efficiently (higher productivity). The first method will increase income earning per unit input only if an increasing return to scale technology exists. Producing greater output using more input would not guarantee for greater profit. This is because an increase in total price of all inputs needs to be calculated and compared with an increase in output value. The second method relates to management strategies to utilize resources efficiently. It is also associated with the growth of capital intensity and labor productivity. High-productivity growth would enable an organization remains in a competitive market and meets its goal. High-productivity growth gives an impact to worker welfare, shareholders gain, and governments (taxes and regulation) and social responsibility. Since most companies operate under several constraint factors, using more input to generate more output is not exclusively a best choice. For example, at the same level of input, it is possible to expand output by reducing waste and defective goods or by employing a new technology and good management system.

A Competitive market has forced producers to operate efficiently with high-productivity level. This condition is a combine impact of globalization, advancement in information technology and shortage of resources and energy. Hence, improvement in efficiency and productivity has become a central topic of deliberation among researchers. The following paragraph presents several studies about efficiency and productivity in the manufacturing sector especially in the food industry sector.

Ali et al. (2007) evaluated the performance of key inputs used in the Indian FPI and had also identified the determinants of productivity and efficiency changes. The results of the analysis suggest that the Indian FPI has growing at a rate of 10 percent per annum. They also found out that, in the last two decades, most sub-sectors have shifted to a constant and decreasing economy of scale from previously increasing economy of scale. Positive TFP change comes from technological progress due to effect of increasing capital input, but contribution of technical efficiency changes to TFP growth is quite small.

Morrison (1997) reported the productivity of FPI in the United Stated in term of structural change and capital investment perspectives. He found that the food processing industry is a leading force affecting the economic performance of US manufacturing sectors. Increase in the capital has more than compensate for the declines in the use of labor in the industry.

Tham (1997) estimated TFP growth for the 28 three-digit industries in the Malaysian manufacturing sector, and identified the determinants of productivity growth during 1986-1991. In his estimation, he put much consideration on both trade policies as well as industrial characteristic. The results showed that the overall TFP growth is quite small. The main contributors of the TFP growth during the study period are the rate of change in both inputs and exports, and foreign investment.

The Malaysia government has identified that the FPI has important contributions to the country's economic growth in future (Ghani, 2004). The challenges currently faced by the food processing industry: (i) food availability and affordability, (ii) inter-sector competition for resources, (iii) market liberalization (competition from imported food), (iv) unstable supply of raw material and (v) inadequate public infrastructure. A study conducted by Warr et al. (2008) in Malaysia, concluded that high income per capita and rapid population growth had increased demand for many imported food products.

Maisom et al. (1993), using division index approach, estimated the TFP growth for the Malaysian industry at the 3-digit level for the period 1973-1989. Three intermediate inputs used in the study were capital, labor and material. The result found positive growth for the majority of the industries. The accumulation of capital per labor was faster, but TFP growth was slower in the heavy industries compared to other industries. This adverse result may be due to the extensive capital subsidies given to the heavy industries as part of import substitution program. The study disclosed a rapid TFP growth in labor-intensive industry. It also showed the transformation of technology from craft or manual to modern and automated had been the driving force of productivity growth. Zahid and Mokhtar (2007) estimated technical efficiency of SMEs in the Malaysian FPI by using stochastic frontier analysis and found inefficiency was 24 percent.

3.5 Concept of Productivity Measurement

In the econometric studies, productivity, technical efficiency and technological change implicitly are derived from a production function or from a cost function. Many methods exist in the literature for the measurement of productivity since early 1940s. The methods such as Kendrick-Creamer model, Laspeyres (price index), Craig-Harris model, Solow residual index, Divisia index, Fisher index, Tornquist index, Cobb Douglas production function, stochastic frontier and data envelopment analysis. Singh et al. (2000) laid all these methods into three fundamental concepts namely index measurement, linear programming and econometrics models. During past three decades, two approaches have been broadly used and popular among researchers. Those are a non-parametric (Data Envelopment Analysis-DEA) and parametric techniques (Stochastic Frontier Analysis-SFA).

Generally, selection of the model depends on the specific condition such as data availability, period of time, etc. Nelson (1990) establishes a productivity measurement model from a production function using divisia index. He assumed that the production function is given as: $Q = f(X_1 \cdots X_n, t)$, where Q = output, the X_i = input and *t* represent time. Total factor productivity is defined as the ratio of Q to an index of aggregate inputs, F. If F is computed using a divisia index, the proportionate growth rate of F, then F may be defined as $\dot{F} = \sum_{i=1}^{n} S_i \dot{X}_i$, where $S_i = w_i X_i/TC$, the cost share of the i^{th} input, w_i is the price of the i^{th} input, TC is the total cost, and $\dot{X}_i$ is the growth rate of X_i. The growth rate of TFP may be defined as $\dot{TFP} = \dot{Q} - \dot{F}$ and the dual cost function defined as $TC = g(P_i \ldots P_n, Q, t)$. The relationship between $\dot{TFP}$ and the rate of technical change, $\dot{RCT}$, totally differentiating the dual cost function above respect to t:

$$\dot{C} = \sum_{i=1}^{n} \text{[illegible]}$$

Final derivation results: $\dot{TFP} = \dot{RTC} + (1 - \varepsilon_{CQ})\dot{Q}$

The model shows a relationship between total factor productivity and rate of technical change (RTC). Notation $\varepsilon_{CQ} = (\partial C/\partial Q)(Q/TC)$ is cost elasticity respect to Q. If the value is equal to unity, then the firm is operating constant return to scale, if it is less than or greater than unity means decreasing and increasing returns to scale respectively.

Azzam et al. (2004) constructed a different model of TFP growth by examining the role of imperfect competition. The model brings together a New Empirical Industrial Organization (NEIO) model that introduced by Good et al., (1999). Using data from 29 FPI from 1972 to 1992, he found that overall changes in mark up economic of scale and demand growth contributed positively to TFPG, while the disembodied technical change was a negative contributor. To decompose

TFPG in oligopoly industries, imperfect competitive was measured as an output price in terms of marginal cost: $P = \phi MC = \phi \varepsilon AC$, where P is output price, ϕ is mark up (defined as one plus the percent of mark-up). If marginal cost is defined as MC = dC/dQ, where C is cost and Q is output and AC denoted as average cost (C/Q), then ε is MC/AC, namely the output cost elasticity.

Cost function is given by C = C (W, W_i, K, Kw ; T), where W_i is price of input, X_i and T denoted as an index the state of technology. From above equation, the rate of growth can be written: $\dot{P} = \dot{\phi} + \dot{\varepsilon} + \dot{C} - \dot{Q}$

Then the rate of cost growth is given by $\dot{C} = \varepsilon \dot{Q} + \sum_{i=1}^{k} k_i \dot{W}_i + \dot{T}$,

where k_i is the proportion of total expenditure on input accounted by the i^{th} input and $\dot{T}$ = (dC/dT)/(1/C) is the percent change in cost due to the rate of change in technology. Hence, the growth of output price can be written as:

$$\dot{P} = \dot{\phi} + \dot{\varepsilon} + (\varepsilon - 1)\dot{Q} + \sum_{i=1}^{k} k_i \dot{W}_i + \dot{T}$$

Since total TFP is a ratio of output to an aggregate factor input (F), it follows that

TFPG = $\dot{Q} - \dot{F}$, i.e. the TFPG is equal to the difference between the growth of output and the aggregate input. From the production function Q = Q(X_1, K, X_k, T), the growth of output is $\dot{Q} = \sum_{i=1}^{k} \frac{dQ}{dX_i}\frac{X_i}{Q} + \frac{dQ}{dT}\frac{1}{Q}$

Cost minimizing behavior to the production and cost functions gives the first-order conditions: $\partial Q/\partial X_i = W_i/MC$ and $\partial Q/\partial T = -\partial C/\partial T\ (1/MC)$. Substituting these into the rate growth output equation yields:

$$\dot{Q} = \sum_{i=1}^{k} \frac{W_i X_i}{MC\,Q} \dot{X}_i - \frac{dC}{M}$$

The aggregate input (F) is defined as the weighed sum of the inputs by using expenditure shares in the total value of output ($=W_iX_i/PQ$) as weights. Similarly aggregate input as:

$$\dot{F} = \sum_{i=1}^{k} \frac{W_i X_i}{PQ} \dot{X}_i = \frac{\varepsilon}{\theta} \dot{Q} - \frac{1}{C},$$

where $\theta = P/AC$. Then the rate of growth of TFP becomes

$$\dot{TFP} = \frac{(\theta - \varepsilon)}{\theta} \dot{Q} - \frac{1}{\theta}$$

Azzam et al. (2004) compares the model to model developed by Good et al. (1999) to introduce the effects of demand shocks for Q in growth rate forms:

$\dot{Q} = \lambda + \eta(\dot{P} - \dot{D}) + \gamma \dot{Y}$, where λ is the demand time trend, η is the price elasticity of demand, D is a deflator, γ is the income elasticity of demand, Y is real income, and other terms are as previously defined. Finally he proposed the final decomposition of TFPG as:

[illegible]

where $B = L/[1-(\varepsilon\eta -1)]$ and $L = (\theta -\varepsilon)/\theta =(P -MC)/P$, the well-known Lerner index of oligopoly power. For diseconomies of scale ($\varepsilon >1$) or weak economies of scale in the presence of inelastic demand, B is likely to be positive.

If economy of scale is strong and price elasticity is relatively high, B is likely to be negative. The effect of increases in mark-up over time, is given by $B\eta\dot{\varphi}$, leads to lower TFPG for $B>0$. Focus on the role of demand growth in TFPG, given by $B(\lambda + \gamma \dot{Y})$. If $B >0$, the demand growth translates into productivity growth, or conversely, a slowdown in demand leads to a lower rate of growth of TFP. The third term, $B\eta\dot{\varepsilon}$, indicates that increases in economies of scale ($\dot{\varepsilon}<0$) result in an increase in TFPG if $B>0$. Azzam et al. (2004) model requires knowledge of parameters: changes in mark-up, the price and income elasticity of demand, the demand growth, economies of size, and the rate of technical change.

These two examples of TFPG measurement (Nelson, 1990 and Azzam et al., 2004), construct the model underlying on their specific objectives in the study. Only limited literatures use the model. The consecutive discussion about measurement of productivity will focus on two approaches, which are used widely in the present productivity study; Stochastic Frontier Analysis (SFA) and Data Envelopment Analysis (DEA).

The original idea of Farrell's efficiency measurement (Farrell, 1957), suggested two approaches to identify the possibility production frontier: (i) parametric function such as Cobb Douglas production function and (ii) non parametric piece wise linear convex isoquant. The first approach of the Farrell's sign then extended by Aigner, Lovell and Schmidt (Aigner et al., 1977) to introduce the SFA method and the second approach extended by Charnes et al. (1978) to introduce the DEA method. SFA needs to specified a frontier production functions, but DEA establishes a virtual piece-wise boundary production function from all observation data and calculates the best practice of a decision making unit (DMU) against it.

3.5.1 Stochastic Frontier Analysis

The SFA is a deterministic parametric concept based on error measurement as an inefficiency level of a production function. The stochastic frontier production model incorporates a decomposed error structure with a two sided symmetric and a one-sided component. According to Aigner et al. (1977), the fundamental model of the stochastic production frontier analysis can be written as:

$\ln y_i = \mathbf{x}_i\beta - u_i$, $i = 1,2,...N$, where $\ln y_i$ is a logharitma scalar of output for the i^{th} firm, x_i is a (K+1) row vector input and $\beta = (\beta_0, \beta_1, \beta_2, \ldots \beta_k)$ is unknown as parameter to be estimated, u is an error term where independent and identically distributed (iid) normal random variables with mean zero and variance σv^2 independent of u :

$v_i \sim N[0,\sigma_v^2]$ and $u_i = |U_i|$, where $U_i \sim N[0,\sigma_u^2]$

A central parameter in the model is the asymmetry parameter, $v = \sigma_u/\sigma_v$; which represents the error component of the data. The variables in the model are in logarithm value to estimate as a linear function. This error term is estimated by maximum likelihood and depicts the inefficiency component. Since maximum efficiency is equal to one, the technical efficiency can be calculated from error term as $1-u_i$. Maximum likelihood estimation technique is different to simple regression analysis using ordinary least square to find the best fit of production function. If one works with a panel data, the model can be used to calculate efficiency and productivity growth in the span of the years. The SFA has applied for instance by Kim and Han (2001), Margono and Sharma (2006), Diaz and Sanchez (2008), Chen et al. (2009) and Melfou et al. (2009) to estimate efficiency and productivity growth.

Kim and Han (2001) decomposed TFP of Korean manufacturing industries using data from 1980 to 1994. He found sources of TFP growth are technical progress, changes in technical efficiency, and changes in allocation efficiency and scale effects. The significant positive effect comes from technical progress and negative effect come from allocative efficiency. The after-effect of the government's industrial policy to promote the heavy and chemical industries was identified in prevalent allocate inefficiency and vanish economies of scale across these industries.

Following to Kim and Han (2001), TFP is decomposed through a translog production function where the production function is defined as :

3.32

$Y_{it} = f(x_{it}, t)\exp(-u_{it})$, Y_{it} is output of firm i ($i = 1\ldots N$) during t^{th} time period ($t = 1\ldots T$), x is an input vector, t is time trend index proxies the technical change and $u \geq 0$ is the output oriented technical inefficiency which varies over time. By a differentiating technique, the production frontier can be noted as:

$$\frac{d\ln f(x,t)}{dt} = \frac{\partial \ln f(x,t)}{\partial t} + \sum_j \frac{\partial \ln f(x,t)}{\partial x_j}\frac{dx_j}{dt}.$$

The first part of right hand side measure change in frontier output caused by technological progress and the second part is change by input use. Suppose elasticity input of input j, $\varepsilon_j = \partial \ln f / \partial x_j$, the second term can be expressed as $\sum_j \varepsilon_j \dot{x}_j$, where dot over the variable indicates its rate of change, rewrite as $\frac{d\ln f(x,t)}{dt} = TP + \sum_j \varepsilon_j \dot{x}_j$, and the change in production can be showed as:

$$\dot{y} = \frac{d\ln f(x,t)}{dt} - \frac{du}{dt} = TP - \frac{du}{dt} + \sum_j \varepsilon_j \dot{x}_j.$$

Actually productivity is not only affected by TP and input use, but also by the change of TE. TP is positive if the exogenous technical changes shift the production frontier upward for a given level of inputs, vice versa. Improvements of TE over time occur if du/dt is negative, and deteriorative if it is positive. Kim and Han (2001) defined TFP growth as:

$\dot{TFP} = \dot{y} - \sum_j S_j \dot{x}_j$, where Sj is *i* share of input *j* in production cost, then TFP growth become:

$$\dot{TFP} = TP - \frac{du}{dt} + \sum_j (\varepsilon_j - S_j)\dot{x}_j$$

$$= TP - \frac{du}{dt} + (RTS - 1)\sum_j \lambda_j \dot{x}_j + \sum_j (\lambda_j - S_j)\dot{x}_j \ ,$$

where RTS ($= \sum_j \varepsilon_j$) denotes the measurement of return to scale, and $\lambda_j = f_j x_j / \sum f_j x_j = \varepsilon_j / \sum \varepsilon_j$. The last part in this equation this measures inefficiency in resources allocation resulting from deviation of input price from the value of their marginal products enable us to decompose into TP, the technical efficiency change (-du/dt), scale components (SC=RTS-1) $\sum_j \lambda_j \dot{x}_j$, and the allocative efficiency change (AE = $\sum_j (\lambda_j - S_j)\dot{x}_j$).

The model developed by Kim and Han (2001) is one of the alternatives model to measure the efficiency and productivity growth in the manufacturing sector. This decomposition means that TE does not affect the TFP growth incase technical inefficiency does not exist or it is time-invariant, as in the Solow's residual approach. However, since the method uses a stochastic frontier model, the model should be consistent with the stochastic properties' assumption such as the firms operating at fully efficient. They maximize profit and minimize cost, so that its implementations depend on availability of input and output price. If the price of input and output are not available, the model may be not a best choice, for example, working with a non-profit organization.

Stochastic frontier approach can also be used to investigate the efficiency in cost function. A traditional cost function assumes that all producers have a cost minimization objective. Couto and Graham (2009) argued that the existing error in this concept is a white noise and possible for a model misspecification. The stochastic cost function recognizes that a cost minimizing firm may not be able to produce a given level of output with given input prices at a minimum cost. This is because of the existence of technical and allocative inefficiencies, which cause deviations from the cost frontier. Therefore, two inefficiency concepts conditionally can be drawn i.e.: first, technical inefficiency associate with the failure of a firm to produce the maximum possible output with some given set of inputs and the second, allocative inefficiency which arises from adopting a sub-optimal choice of input proportions given the input prices. These two inefficiencies increase the total cost. Moreover, an economics frontier is based on a single optimization upon the entire data set. In this case the fittest technology is an average estimate which may not replicate the behavior at each decision making unit (Tubene, 1997).

3.5.2. Data Envelopment Analysis

A nonparametric Data Envelopment Analysis (DEA) model is a more popular method to investigate efficiency and productivity in many fields of economy. DEA is an extended method to replace the original Deterministic Frontier Analysis (DFA). Mahadevan (2002) argued that DEA is a promising alternative technique to understand and identify the sources of productivity growth.

Charnes et al. (1978) developed the non-parametric Farrell's idea by using the concept of the envelops theorem. They were initially introducing the term DEA and Decision Making Units (DMU). After this period the DEA method is used extensively to measure efficiency and productivity. A great number of articles use DEA have been published. Fare et al. (1994) provides an exhaustive discussion of inter temporal production frontiers with dynamic DEA.

Non-parametric means no statistical or mathematical programming approach for considering the optimum solutions relative to individual units rather than assuming as in optimized regression. DEA is applicable to the problems without engaging to a statistical test or to specification of production function such as cost minimization and revenue maximization (Tubene, 1997). In the statistical theory, envelop theorem is defined as a comparative static relationship between the derivatives of an objective function and the derivatives of the associate value function. For unconstrained optimization, the theorem states the marginal effect of a parameter (on the maximum value of the objective function), we can treat the selected variable as constant. The marginal effect of any parameter is equal to the marginal effect of that parameter on the objective function (Baldani et al., 2005).

Two primary orientations of the DEA to assess economic efficiency are input oriented and output oriented. Input oriented based the measures on considering how the inputs may be reduced relative to a desired output level, while the output oriented considers how output could be expanded at given input levels. DEA has been employed broadly as a tool of analysis in efficiency and productivity studies

(Mahadevan, 2002; Tubene, 1997; Wu and Ho, 2007; Shestalova, 2003). The DEA easily permits an assessment of a multiple input, multiple output of technology.

Basic Model of DEA

The basic model of DEA is CCR model developed by Charnes, Chopper and Rhodes (Charnes et al. (1978). Suppose *n* decision making unit (DMU) each producing *s* different output by consumes varying amount of *m* different inputs. If firm A is capable of producing Y(A) units of output with X (A) unit inputs, then other producers should also be able to do the same. Similarly, another firm, B is capable of producing Y(B) units of output with X(B) inputs. Then other firm should also be capable of the same production schedule. Firms A, B, and others can then be combined to form a combination of inputs and outputs as well. Since these combined firms do not necessarily exist, it is sometimes called as the virtual firms.

In the DEA concept, the observed firms are usually called as a decision making unit (DMU). A particular DMU_j using x_{ij} of input *i* to produce y_{rj} of output r, x_{ij} and y_{rj} greater than unity. Each DMU at least has one positive input and output respectively. From this assumption, we can go to CCR DEA model by the ratio of output and inputs to measure relative efficiency of $DMU_j = DMU_o$ to be evaluated relative to the ratios of all n DMU, j = 1,2….n. The CCR model constructed as the reductions of the multiple outputs divided by multiple inputs to a single virtual output and virtual input. A maximization mathematical equation will form the objective function for the particular DMU:

$$\text{Max } h_o(u,v) = \sum_r u_r y_{ro} \Big/ \sum_i v_i x_{io} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.1)$$

where u_r's, v_i's and x_{io}'s are observed output and inputs of DMU that will be evaluated. This equation's constraint is that the virtual output to virtual inputs ratio less than or equal one, so that (3.1) can be re-write:

$$\text{Max } h_o(u, v) = \sum_r u_r y_{ro} \Big/ \sum_i v_i x_{io}$$

Subject to

$$\begin{aligned} &\sum_r u_r y_{rj} \Big/ \sum_i v_i x_{ij} \le 1 \text{ for } j = 1, \ldots, n \\ &u_r, v_i \ge 0 \text{ for all } i \text{ and } r \end{aligned} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.2)$$

Replaced u_r, v_i ≥ 0 with $\frac{u_r}{\sum_{i=1}^{m} v_i x_{io}}$, where $\frac{u_r}{\sum_{i=1}^{m} v_i x_{io}} \ge \varepsilon > 0$ will guarantees the solutions will be positive in the variable (ε is a non-Archimedean constants with value smaller than zero). Equation (3.2) results an infinitive solution; if (u^*, v^*) is optimal, so that, $(\alpha u^*, \alpha v^*)$ is also optimal for $\alpha > 0$. CCR selects a solution that change variables from (u,v) to (μ, *v*) then:

$$\max z = \sum_{r=1}^{s} \mu_r y_{ro}$$

$$\text{subject to} \quad \sum_{r=1}^{s} \mu_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \le 0 \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (3.3)$$

$$\sum_{i=1}^{m} v_i x_{io} = 1$$

$$\mu_r, v_i \ge 0$$

Dual problem of this linear programming is:

$$\theta^* = \min \theta$$

Subject to

$$\sum_{j=1}^{n} x_{ij} \lambda_j < \theta x_{io}, \ldots i = 1,2 \ldots m$$

$$\sum_{j=1}^{n} y_{rj} \lambda_j \ge y_{ro}, \ldots . r = 1,2 \ldots s \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.4)$$

$$\lambda_j \ge 0, \ldots\ldots\ldots\ldots j = 1,2 \ldots n$$

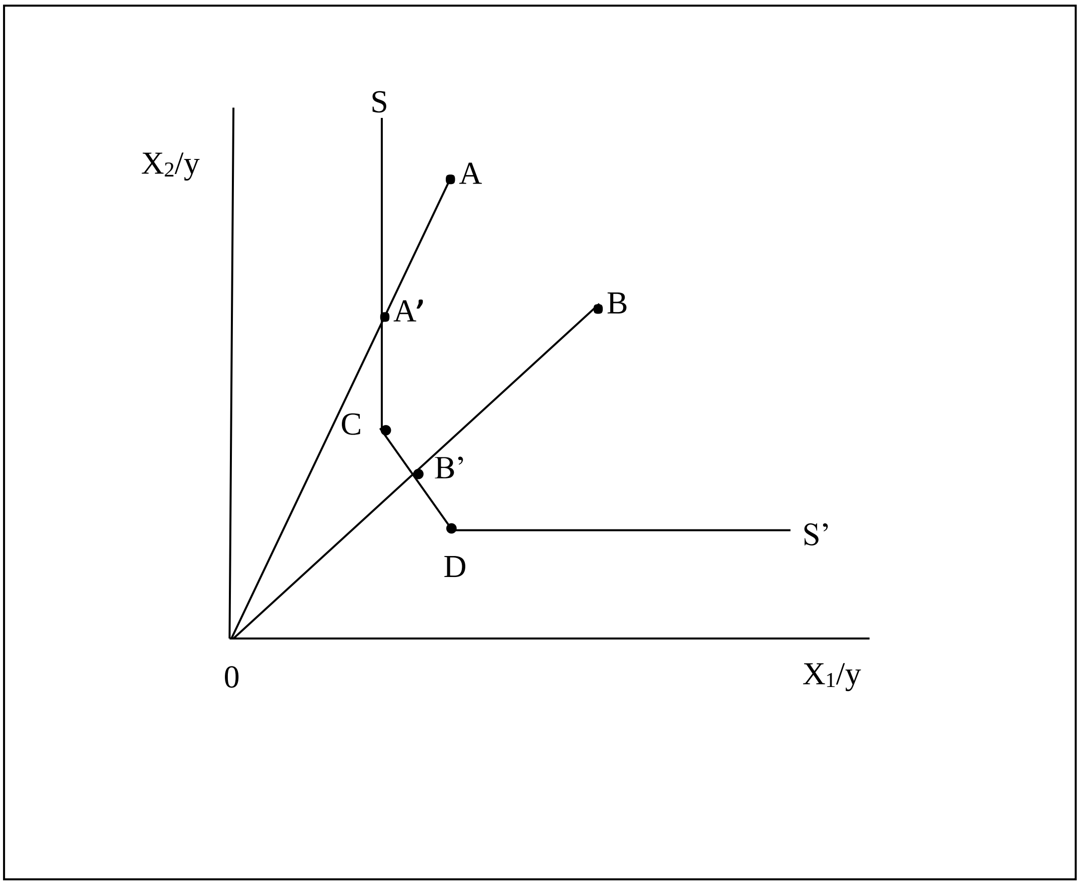
The implicit of dual theorem of linear program enable one to measure efficiency by equation (3.4) because it can be set θ =1 and λ_k^* =1 with λ_k^* = λ_o^* and all other λ_j^* = 0, however this solution imply $\theta \le 1$. The measurement of θ is said as optimal solution (efficiency score) for a particular DMU and the process go over to each DMU. If the value is close to unity, it means more efficient DMU and vice versa. The DMU is operating at its boundary efficiency (maximum efficiency level) if the θ is equal one.

Compare to the translog index approach, DEA has advantages. The translog index approach ignores technical inefficiency and only calculates the technological change, which is inaccurately interpreted as TFP growth. In the productivity literature, TFP growth is comprised both of technical change (frontier shift) and technical efficiency (catching up effect). Then the translog index approach calculates TFP growth as a residual measuring 'anything and everything' of output growth not accounted by input growth. DEA is able to identify the sources of TFP growth and useful for policy prescriptions (Mahadevan, 2002).

However, DEA is not free from drawbacks either. These drawbacks include measurement error, which the statistical noises are assumed to be non-existent, and it does not allow for statistical tests typically of the econometric approach. Coelli et al. (2003) discussed slacks as other problems in DEA method.

Slacks of DEA

If one measures the efficiency using DEA, the piece-wise linear frontier runs parallel to the axes. The efficient firms are operating on the possibility production function. However, from input and output side it can be seen that along the possibility frontier curve, input or output is still possible to be more optimally without deteriorating other factors. To illustrate this slacks suppose two inefficient firms (A and B) operating out of the frontier function and other two firms (C and D) operating on the frontier. From Figure 3.3 below, we can see that firm A has been technical efficient as OA'/OA and firm B has TE: OB'/OB.



Source: adopted from Coelli, et al., (2003)

Figure 3.3. Input Slack of DEA Measurement

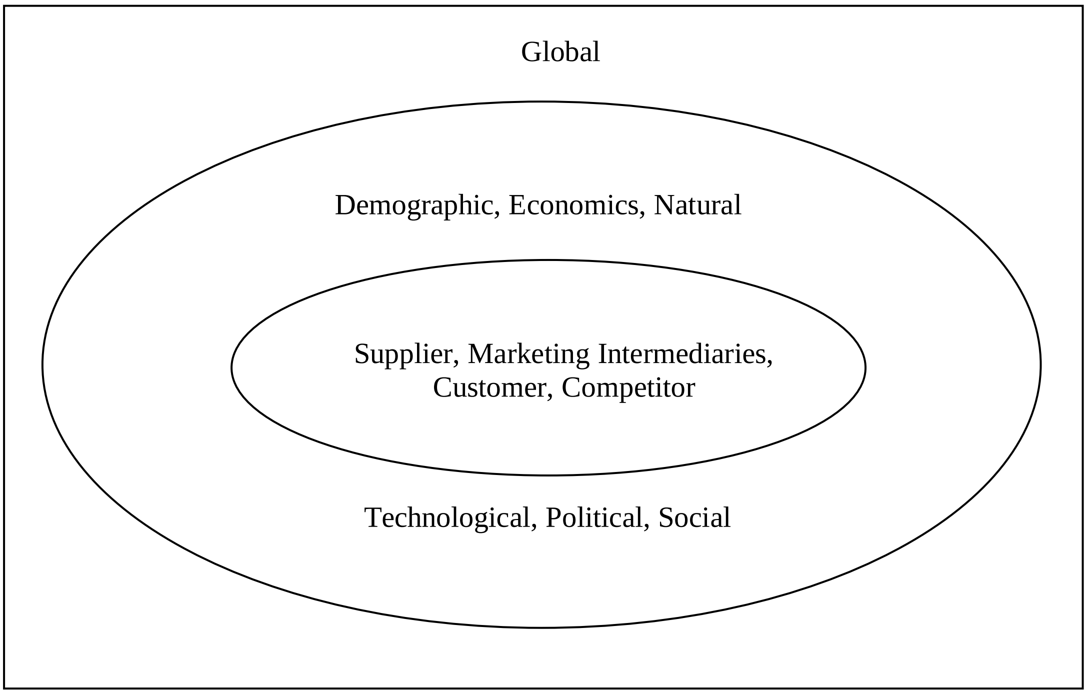
The question is, whether A’ is a really efficient, whereas at the constant output it is possible to reduce input x_2 to be same as used at point C’. This condition is called as *input slack* and by using the similar way one can describe the *output slack*. To accurate the analysis result of efficiency and productivity using DEA this slack should be stated. Coelli et al. (2003) explained that the output slack will be equal to zero if an only if $Y\lambda\text{-}y_i = 0$, and the input slack will equal to zero if and only if $\theta x_i - x\lambda = 0$ (given the optimal value of θ and λ).

Malmquist Productivity Index

In DEA concept, if one work with panel data, total factor productivity change over the year can be investigated by using Malmquist productivity index. This index measure productivity growth from distance function of two data point (Coelli et al., 2003). More discussion about Malmquist TFP index is presented in Chapter 4, section 422.

3.6 Determinants of Productivity Growth

The performance of food processing industry, directly or indirectly, influenced by many factors, which originated from, both micro and macro environment. Ing and Christy (1999) identified factors from the micro level were suppliers, marketing intermediaries, customers, competitors and publics. Factors from the macro level classified into six categories: demographic, economic, nature, technology, politic and social; as illustrated in Figure 3.4. Population demography such as size, age, ethnicity, and religion and education level had significant influenced on the consumers' tastes and preferences. These factors relate to the consumer's demand and form the basis of distinguishing a group. Nature does play a significant role to the food processing industry as it keeps constant supply of the raw materials. The environmental issues can be a determinant as activists brought forward their cases, which eventually gave pressure, to the industry.



Sources: Adopted from Ing and Christy (1999)

Figure 3.4 Micro and Macro Factor Determine Food Processing Industry

Another factor affecting the performance of food processing industry is technology. Technology plays a crucial role in generating value added, fulfilling ever changing consumers' demands and reducing production cost. Government regulations, industry association and NGO also influence the food industry operation. Factors like labor regulation, women's right, minority right, and senior citizen right do have an impact on industry's performance. These six micro and macro factors are decisive in reorganizing and restructuring the food processing industries.

Productivity and efficiency analysis is the first step in effort to improve the performance of an organization. The formulation of alternative strategic policies is usually the follow-through exercise after the analysis. The exercise maybe paramount to policy makers and stakeholder, but more importantly, is the understanding of the determinants and uses them to improve the organization's performance. Morison (2000) suggested the ensuing productivity analysis had to recognize the factors influencing the performance by decomposing the measure. He further suggested the refinement of the input and output measures and distinguished other aspects of the underlying technological and behavioral structure. The objective, whether expressed explicitly or implicitly, of all the activities in the productivity field is to find the determinants of performance.

The study of efficiency and productivity of an organization often employed two-step analysis procedure. The first step measures the efficiency and productivity level, and the second step uses regression method to identify the determinants of the efficiency and productivity (McDonald, 2009). Yu (1998) employed one-step and two-step procedure on his study. For one-step procedure, the equation includes the exogenous variable. However, in the two-step procedure, the first step estimates efficiency and productivity using DEA method and then places the result as a dependent variable in the second step. There is no significant difference in the effect of one-step and two-step procedure as long as the exogenous variable correctly identified in the one-step procedure. However, the effect of the explanatory variable is significant for the two-step procedure.

The studies of determinants of productivity growth in the manufacturing sector and food processing industry have been well documented. Dewan and Kraemer (2000) reported the difference of IT capital allocation between developed and developing countries. In developed countries, new capital investment for IT accounted for as much as 53 percent of the annual GDP growth. A non-IT capital with almost 20 times the IT factor share, accounted for just 15 percent of GDP growth. However, in developing countries non-IT capital is 49 percent of the GDP growth and non IT capital investments is 49 percent of the GDP growth. The following sections provide several determinants of the productivity growth in the manufacturing and industrial sector obtained from the current literatures.

3.6.1. Foreign Ownership

During 1990s, researchers included ownership as one of the variable in a productivity analysis model. The theory behind the inclusion of this variable is that the management system significantly affects the production while the owner's management style has influences on the management system. Benfratello and Sembenelli (2006), Jefferson (2000), Harris and Robinson (2003), Isik (2007), Hill and Snell (1989) put ownership as a variable in their productivity analysis. The productivity theory divides firm ownership into two categories, i.e., domestic ownership and foreign ownership. Each of the ownership categories has different leadership style especially in controlling and managing the firm. These differences are due to factors like contrasting experience, system management, use of technology, size of the company and personal education. Foreign ownership usually exists in a large-scale firm which operates as multinational enterprises while domestic ownership mostly exists in small and medium enterprises. However, many of the foreign ownership companies formed a joint operation with the domestic firms to surmount all business barriers in the host country.

Over the last decades, the studies on operational management increased manifold. A lot of the studies focused on the correlation between types of ownership and firm performance. Margono and Sharma (2006) investigated the productivity of Indonesian manufacturing and found the domestic ownership had a negative impact on the productivity. Hill and Snell (1999) developed and tested a model to investigate the differences in productivity level of firms with different ownership structure as an influential factor in productivity growth. Ownership structure placed just behind R&D and capital intensity as the factors determining firm productivity.

Benfratello and Sembenelli (2006) estimated the effect of foreign ownership on productivity in a general setting by controlling all endogenous sources, including the simultaneity of the ownership. They found that nationality of ownership is a determinant of productivity performance. It was also found that firms owned by or joint-ventured with US companies tend to be more productive than locally-owned firms.

3.6.2 Research and Development

Research and development (R&D) expenditure is a decisive factor affecting the productivity of a firm. Practically, the allocated budget used in developing a new product, inventing new technique in the production process, exploring new material or improving management system for consumer satisfaction. Empirical studies reported that R&D is a significant determinant for productivity growth (Lambertini et al., 2004; Andersson, 2001; Ascari, 2004; Bronzini and Piselli, 2009 and Coe et al., 2009). Girma and Wakelin (2007) revealed that average R&D budget for a foreign-invested firm was greater than locally-owned firm.

In developing countries, the government provides funding facility for firms to initiate R&D activities. Whereas, in developed countries a large proportion of R&D budget usually funded by the private sector. For instance, in Japan only 19.6 percent of R&D expenditure funded by the government, while the remaining largely contributed by the private sector. In the US as much as 48.2 percent of the fund contributed by the government budgetary allocation and the remaining by the private sector (Goto and Suzuki, 1989). Using Cobb Douglas production function model, they found that R&D gave positive contribution to the productivity growth in Japan's manufacturing industries, especially in the electronic sub sector.

3.6.3 Openness

Trade openness describes the intensity of both forms of trading activities, i.e., inflow (import) and outflow (export) of a nation. Globalization in the international trade environment characterized by lower tariff barrier, electronic banking technology, transportation and establishment of free trade agreement encouraged many governments to intensify their trading activities with other countries.

Openness defined as the proportion of total export and import value to the GDP (Alcala and Ciccone, 2004; Ang, 2008). A different measurement of openness provided by Athukorala and Sen (1998), which designates openness as a binary variable in a model, i.e., 0 for close economic and 1 for open economic. Five criterions used to adjudge a country openness: (1) non tariff barrier coverage on intermediate and capital goods imports of 40 percent or more; (2) an average tariff on intermediate and capital goods imports of 40 percent or more; (3) a black market exchange rate that depreciated by 20 percent or more relative to the official exchange rate; (4) a socialist economic system and (5) state monopoly on main export. A country would be identified as having an open economic if it possessed none of these five criterions.

A number of studies disclosed the effect of openness to the economy and productivity growth. Amity and Konings (2007) focused on the impact of lower tariff of intermediate inputs on productivity. Avellino et al. (2005) found that openness had significant positive impact on the resources devoted to education.

Anderson (2001) argued that market and industry, as a whole, becoming more efficient as more and more nations opens up their economies. Through openness, inefficient firms would make way for more efficient firms to compete in a highly competitive global market. The rate of entry and exit of firms into the global market can be identified as determinants of productivity for FPI.

Chang et al. (2009) tested the hypothesis that the effect of trade openness on economic growth may depend on complementary reforms that help a country to take advantage of international competition. Work on country-wide panel data produced the result which supported the above-mentioned hypothesis. Temple (2002) investigated the possible association between openness, trade and the slope of the output-inflation. He found little evidence to support the argument that an open economy has a lower inflation rate. An empirical study by Weinhold and Rauch (1999) on less developed countries revealed that increased openness lead to increase in specialization through learning by doing. Specialization accelerates productivity growth by fully realizing dynamic economies of scale.

Goldar and Kumari (2002) suggested that openness of the economy provides at least six favorable effects on enhancing the industry's productivity: (1) imported capital goods and intermediate goods, which embodies advanced technology, are readily available with cheaper price; (2) greater availability of imported intermediate goods will enable firms to get new technology; (3) heightened competitive pressure compelled the industry to utilize their resources efficiently; (4) greater progression of technological advancement in industrial firms as opportunities for acquiring imported technology and capital goods expanded; (5) the average level of industry efficiency should improve because such environment forced inefficient firms to exit; (6) coupling effects of high accessibility of imported inputs and pragmatic exchange rate due to trade liberalization enable industrial firms to compete effectively in export markets.

Yusop and Masron (2007) argued that openness is a crucial element related to the variation in the efficiency of investment and productivity. Openness is also linked with the adverse selection phenomenon in the developing country that resulted from inefficient allocation of resources and low TFP. Grossman and Helpman (1990), Anderson (2001), Avelino et al. (2005) and Diao et al. (2005), noted that openness provides the industry with greater ability to absorb the technological benefits from foreign countries. These technological benefits are essential for productivity and efficiency in the manufacturing sector.

3.6.4 Public infrastructure

Public infrastructures have a considerable influence on the overall environment of the industry. This is particularly true for indirect production cost. Development of public infrastructure like roads, airports, ports and markets, in many ways, influences productivity of industries especially by lowering operation cost. As an example, the construction of expressway from industrial plants to port directly affects the transportation cost of the product. Bougheasa et al. (1999) modeled the relationship between infrastructure, bilateral and transportation cost. The relationship model between the level of infrastructure and the volume of trade showed a significantly positive association. The measured value of public infrastructure is critical to the policy process and management study. Bernstein and Mamuneas (2008), Bronzini and Piselli (2009) reported public infrastructure as a determinant of industry productivity.

Constructions of public infrastructures are almost entirely funded and developed by the government. The private sectors' decision to invest in public infrastructure projects usually subjected to level of infrastructure capital. This means that changes in public infrastructure capital, would eventually, lead to changes in the private sector production processes (Bernstein and Mamuneas, 2008). In the long run, public infrastructure will positively affect regional productivity (Bronzini and Piselli, 2009).

Adelaja et al. (2000) disclosed a declining number of establishments of food industry in New Jersey. He argued that the phenomenon congruent with the negative growth rate of population in the region. However, other factors identified as a possible cause for lower competitiveness includes changes in the regional distribution of income, changes in labor productivity, rising labor and business cost, declining availability of water and waste disposal infrastructure, and the increasing stringency of environmental regulations. Cahill (2004) noted a conclusion from an empirical study on Canadian FPI that the growth of public infrastructure lowered the cost of production since early 1980. It also gave positive impact to the total factor productivity growth.

3.6.5 Foreign Direct Investment

Economists identified Foreign Direct Investment (FDI) as a factor in creating robust economic growth over the past five decades. Countries with robust economic growth, typically, received a considerable amount of investment from abroad. Choi (1991) identified the effect of FDI on the host country economy which includes income effect from the job creation, transfer of innovative technology, management know-how and other intangible assets. A string of benefits associated with FDI led many nations to remove many trade barriers in order to attract inward capital movements. Barrell and Pain (1997) estimated total world's FDI in 1994 was around 9.5 percent of the world output. This percentage had risen from 4.5 percent recorded in 1975. The FDI generated sales value, through affiliation with domestic companies, exceeding 25 percent of the value of world exports. Walkenhorst (2001) indicated that firm size, privatization speed, value-added, and import share are key determinants of food industry FDI.

There is a large body of theoretical as well as empirical literatures on the relationship between foreign direct investment and industry productivity. Harris and Robinson (2002), Willkinson (2004), Helpman (2006), Benfratello and Sembenelli (2006), Yasar and Morrison (2007), Girma and Wakelin (2007), Mullen and Williams (2007), empirically tested the contribution of foreign direct investment to the productivity. Ang (2008) examined the determinants of FDI for Malaysian economy and concluded that FDI had a positive impact to real GDP. Through FDI, the host firm gained the innovations that also become the determinants of productivity (Dimara et al., 2008). Menwhile, Hubert and Pain (2001) noted the benefits of FDI as a source of new ideas, technologies and working practices. Spillovers from FDI to the host country can be translated many ways; contact with the local suppliers, learning by doing, transfer of knowledge from the foreign firm experts to local labor. The potential of external benefits becomes pivotal reason as to why government and regional development agencies actively attracting FDI by offering investment incentives.

There are many factors influencing the flow of the FDI to a nation such as macro-economic indicator, law enforcement, labor and entry cost. Barseghyan (2008) investigated the relationship between entry cost and productivity and found that output per worker reduced significantly due to higher entry costs. This relationship inevitably deteriorates TFP. An increased in entry costs by 80 percent of income per capita estimated to decrease total factor productivity and output per worker by 22 percent and 29 percent, respectively. The flow of FDI into a host country primarily in the form of multinational enterprises from more developed countries to less developed countries. These FDIs require public infrastructure such as transportation, communication and other services to be in place in a host country for them to operate and function optimally.

Helpman (2006) believed that FDI is among the fastest growing economic activities in the world. In 2003, the volume of world merchandise and service export was close to USD 9.1 trillion, where the FDI accounted for USD 560 billion. This figure revealed that FDI alone generated almost six percent of total world export. In Britain industrial sector, Harris and Robinson (2002) studied the effect of FDI on acquisition of local firm by foreign investors. Results from the existing hypothesis showed signs of declining productivity on some firms after undergoing acquisition by FDI. This scenario is consistent with the hypothesis that difficulties faced by a local firm in adapting into the new organization.

The trend in the global economics, not until recently, shifted to support the trade liberalization. The existing theory emphasized the role of trade liberalization to form more efficient market. This theory is not easy to be implemented in some countries. Some countries have their own precedence such as the need to control selected commodities due to domestic demand and supply protection. Liberalization of agro-based commodity trade influenced the food processing market both in the supply and demand side. Regmi and Gehlhar (2005) suggested the slowed growth witnessed in the trade of processed food products in the US caused by the liberalization of transaction for agricultural products. The rules favor the trade of fresh commodities at the expense of processed food. McCullough et al (2008) found that FDI marked the globalization of the food retail and the agribusiness. In the Asia and Latin America FDI grew substantially between mid-1980s through to mid-1990s, but in Africa, the growth remained extremely low. Particularly for Asia, FDI in the food industry nearly tripled from US$750 million in 1988 to US$2.1 billion in 1997. In Latin America the value increased tremendously from US$ 200 million to US$3.3 billion during the same period.

3.6.6 Energy Price

Many authors noted that fluctuations of world oil price have a significant effect on economic activity (Rotenberg and Woodford, 1996). They proposed the theory about the relationship between higher energy price and productivity change. During 1970s, the study on the impacts of energy price to the productivity growth given the highest precedence. Jorgenson (1981) found that higher energy price was a crucial determinant, which slowed down the productivity growth of a large proportion of the U.S. industries. Similarly, the productivity growth decreased as the prices of labor input and capital inputs increased. With the same argument, Wood (1990) explained that it was a consistent hypothesis to say that the rapid changes in productivity growth may be synchronizes with energy price shocks. However, it does not explain the entire scenario of the productivity slowdown.

Dhawan et al. (2010) argued that the soaring of energy price was not the main cause of the recessions that happened in the 1970s and 1980s. Based on the result of their simulation model, spillover effect of productivity on TFP was the main cause of the recessions. After 1982, this spillover effect disappeared, which then reduced the volatility of TFP and, thus, that of macro variables.

3.7 Analysis the Determinants of Productivity Growth

Identification the determinants of productivity growth are important for improving the performance of an organization. However, economic theory does not supply a theoretical model of the factor affecting the efficiency (Lovell, 1994). There are many methods which can be used for this goal, however the proper model depend on the conditional and characteristics of data. Regression technique is the common one, by putting forward the total factor productivity growth as dependent variable and endogenous or exogenous factor as independent variable.

Yu (1998) pointed out two basic approaches to examine the effects of explanatory variables on productivity and efficiency: (i) a one-step procedure which includes the exogenous variables directly in estimating the efficiency measures. Stochastic frontier analysis is common in this type, and (ii) a two-step procedure which first estimates the relative efficiencies using inputs and outputs, then analyzes the effects of the exogenous variables on the efficiency using regression method. In his empirical study, Yu (1998) showed that the magnitude of exogenous variables does not appear to have any significant effect on the performance of the one-step stochastic frontier method as long as the exogenous variables are correctly identified and accounted for. However, the effects of exogenous variables are significant for the two-step approach, especially for the DEA methods.

In the present study, a two-step analysis was used. In the first step measuring productivity growth using DEA and in the second step, we identify the determinants of the productivity growth by employing tobit regression method. Tobit regression is suitable because we want to identify the determinant of growth, so that a positive value can be censored at lower limit zero (Choi, 1991; Chay and Powell, 2001; Ogunyinka and Ajibefun, 2004; McDonald, 2009).

Tobit Regression Analysis

Tobit method is a regression model applicable if the range of the dependent variable is constrained in some way (Amemiya, 1984). The model is called as a censored or truncated regression model where the observations on the dependent variable y_i are censored (or unobserved) if $y < c$. The explanatory variables, however, y is observed for all i. In the truncated regression model, by contrast, neither the dependent nor the explanatory variables are observed if $y_j < c$. In the model, $y^* $ can be less than c, but these observations with $y^* < c$ are not observed because of censoring.

The tobit model originally proposed by James Tobin (Tobin, 1958) by arguing that to influence the relationship both the probability of limited responses and the size of non-limit responses, an explanatory variable may be expected. If one works only to the probability of limit and non-limit responses to be explained then probit analysis is a suitable method, but it is inefficient to throw away obtained information of the dependent variable. If only the value of the variable were to be explained without concentration of observations at a limit, here is an appropriate technique to employ multiple regressions. However, when there is such concentration, the assumptions of the multiple regression models are not realized. Based on this constrain, Tobin proposed a new model for regression technique namely tobit regression analysis.

Some literatures evidence that OLS's output shows not significant results for all variables if working with the small number of data or with a limited dependent variable. Tobit regression can avoid this problem because it maximizes the value of likelihood function (or maximum likelihood estimation - MLE). Chay and Powell (2001) noted that a regression model is considered as a censored model if the recorded data on the dependent variable cuts off the outer surface at the endpoints of that range. Using a standard OLS regression results a biased coefficient estimates. The limit observations arise because of non-observable. In practical work these limit of observations often arise more by individual choices. For instance, in the case of automobile expenditures (Tobin, 1958), the zero observations arise because some individuals choose not to make any expenditures. It is not the case that they are negative and substitute zero for y* because of non-observable.

CHAPTER 4

METHODOLOGY

This chapter discusses theoretical framework and method for the efficiency and the productivity analysis. The discussion starts to elucidate the conceptual framework in section 4.1, model specification in section 4.2, panel data analysis in section 4.3. Section 4.4 presents tobit regression analysis and section 4.5 provide the discussions of variables and data.

4.1 Conceptual Framework

Basically, efficiency can be defined through two different ways: (i) ratio of actual input to the minimum input at a given level of the output, or (ii) ratio of actual output to the maximum output at a given level of input. The first definition is known as input oriented efficiency and the second one is output oriented efficiency. This ratio is measured on its possibility production frontier (optimal position). In case the optimum ratio is relaxed to the firm’s goal, i.e. minimization cost and maximization revenue, then the efficiency is termed as economic efficiency (Fare et al., 1994).

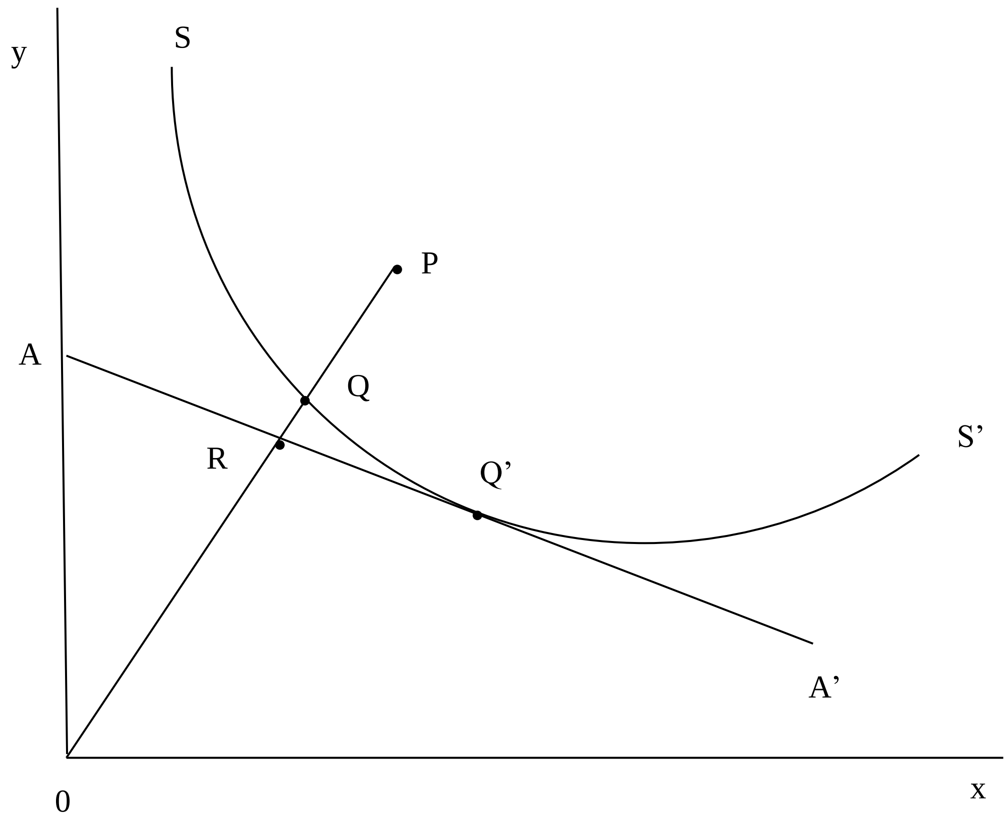
Concept of efficiency measurement has been proposed by Farrell (1957) in his phenomenal article entitled “Measurement of productive efficiency”. Farrell (1957) developed an efficiency measurement by using multiple inputs, which is drawn from work of Debreu (1951) and Koopmans (1951). They derived a structural efficiency from a firm’s isoquant function by simply weighted its average to the same isoquant of other firm’s function. Many researchers then extended the concept to develop a new method of efficiency measurement (Lovell, 1994; Greene, 2003; Heshmati, 2003). The concept of economic efficiency provides a theoretical basis in the operational management policy. It is a useful tool to evaluate the performance of an organization, regardless profit or nonprofit organization.

Farrell’s efficiency concept has two components, namely Technical Efficiency (TE) and Allocative Efficiency (AE). TE reflects the ability of a firm to gain maximum output from a given inputs, while AE reflects the ability of a firm to use inputs optimally at their price and technology. Combining of these two efficiencies bring to the measurement of total Economic Efficiency (EE). Lovell (1994) modeled EE through imposed minimum cost to the actual cost on a production function. The cost minimization is used to measure AE, which can also be calculated from the ratio of EE to the TE. More developed concept of the efficiency measurement comes from work of many economists, for instance; Afriat (1972), Aigner et al. (1977), Charnes et al. (1978), Fare et al. (1994) and Coelli et al. (2003).

Kumbakar and Lovell (2003) argued that the models for efficiency measurement was established by two paradigms; input oriented and output oriented. The input oriented calculates the minimum cost of input to produce output while the output oriented measures the maximization of output at a given level of input.

4.1.1 Input Oriented Efficiency

To illustrate the input oriented efficiency in a simple model; suppose a firm employs two inputs to produce single output under assumption Constant Return to Scale (CRS). By this assumption, it allows the relevant information to be presented in an isoquant curve (Figure 4.1).



Source: Adopted from Coelli et al. (2003)

Figure 4.1 Concept of Technical Efficiency Measurement

In Figure 4.1, the production function assumes a Constant Return to Scale (CRS) technology. Point *P* is a combination of the two inputs (*x* and *y*) to produce a unit of output for an observed firm. The isoquant *SS*’ represents all set combinations of these two inputs to produce output at fully efficient operation and point *Q* is an efficient firm also use these two inputs. It can be observed that *Q* produces output as same as *P* but employs input at a fraction of *OQ/OP* only. In other words, the firm operating in point P potentially can reduce input as much as QP to produce the same level of output. Farrell (1957) defined this fraction of *OQ/OP* as technically efficiency (TE) of the firm *P*.

$$TE_i = OQ/OP \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.1)$$

Alternatively, this value can be calculated as one minus *QP/OP*. The efficiency score was varying from maximum one (100 percent efficient) to the minimum zero (0 percent efficient). If the TE is equal to one means the firm is operating perfectly on the production frontier and score zero means the firm is operating at indefinite distance from the isoquant production frontier. Slope of curve *SS*’ is negative, which imply the increasing of input per unit output will deteriorate the *TE* (ceteris paribus). If price ratio of the inputs is known as the slope of curve *AA*’ then the best combination (the minimum cost) of the inputs can be determined as point *Q*’. Even point *Q* and *Q*’ has same *TE* (100 percent), point *Q*’ is an optimal combination of input to produce the output. This curve *AA*' enables one to measure the AE, but in his original idea Farrell (1957) said this is a price efficiency measurement.

$$AE_i = OR/OQ \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.2)$$

The distance of *RQ* represents the potential reduction production cost of *Q* to catch fully TE and AE at point *Q'*. This condition is known as total Economic Efficiency (EE) which defined as the ratio:

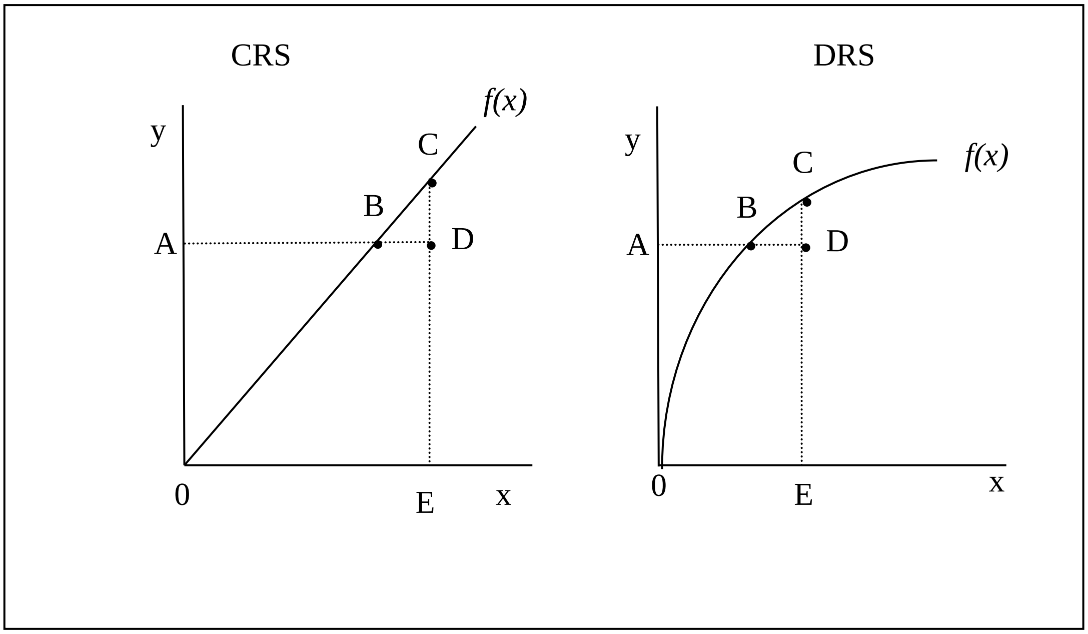
$$\begin{aligned} EE_i &= OR/OP \\ &= (OQ/OP) \text{ x } (OR/OQ) \\ &= TE_i \text{ x } AE_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.3) \end{aligned}$$

This calculation assumes that the efficient production function of the firms is identified. However, in practical, it is difficult to know the function unless from a large bunch of data (Coelli et al., 2003).

4.1.2 Output Oriented Efficiency

From the Figure 4.1 above, one can perceive the amount of reducible input to obtain the same level of output. Vice versa, it possible to see, how much the output can be expanded by using the same level of input. This is the principal concept of output oriented in the efficiency measurement. The difference of input and output oriented was illustrated by Coelli et al., (2003) on a CRS and a Decreasing Return to Scale

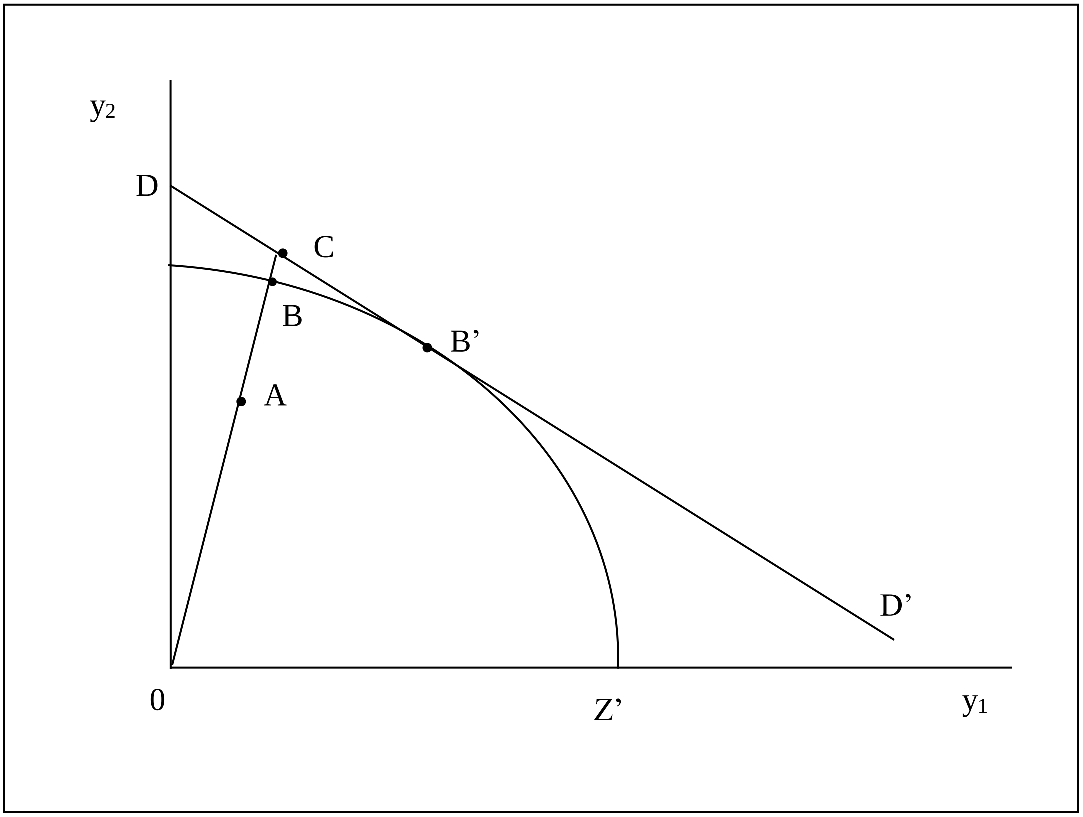
(DRS) graph as per the Figure 4.2. For a simple explanation, suppose a firm uses one input and one out put in a production function. Firm *B* and *C* are operating at the frontier of production function, which are called as the efficient firms. Firm *D* both in CRS and DRS is operating at the out layer of the frontier and called as the inefficient firms.



Source: Adopted from Coelli et al.(2003)

Figure 4.2 Differences between Input and Output Efficiency Measurement

Firm *D* can increase its output to the same level as the firm's *C* without employing extra input, so that, the TE is defined as *ED/EC*. The output and input oriented measures are identical if the firm operating at CRS technology. To demonstrate this output oriented measures, we assume a firm produces two outputs (y_1 and y_2) by employing single input factor *x* (Figure 4.3).



Source: Adopted from Coelli et al. (2003)

Figure 4.3 Concept of Output Oriented Efficiency Measurement

Figure 4.3 depicts the output oriented measurement, where the curve *ZZ*' represents the possibility production frontier. The firm operating at the point *A* is an inefficient firm because it lies under the best production *ZZ*'. The firm potentially can expand output without requiring extra input as much as *AB*. This is a similar way of cost reduction function in the input oriented as per discussed previously. Distance *AB* shows the technically inefficiency level of the firm *A*, hence the technical efficiency is:

$$TE_o = OA/OB \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.4)$$

If the price of output is available, we can draw AE from the iso-revenue line *DD*' as:

$$AE_o = OB/OC \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.5)$$

The highest revenue is obtained in the asymptotic of point B' rather than point B, although they have the same full TE (100 percent). The overall economic efficiency is calculated by:

$$\begin{aligned} EE_o &= OA/OC \\ &= (OA/OB) \times (OB/OC) \\ &= TE_o \times AE_o \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.6) \end{aligned}$$

A firm can moving forward his operation closer to the production frontier by two ways; cost minimization or revenue maximization. The economists combine these two ways to get an optimal efficiency measurement. Fare et al. (1994) used Data Envelopment Analysis (DEA) to measure profit efficiency along with TE, which considers simultaneous increasing output and decreasing output.

4.1.3 Productivity Measurement

Productivity is a relative concept, which cannot be said as high or low, unless a comparison is made. In practical, sometimes productivity becomes a vague term. The common misunderstand, for instance, to synonym the productivity and production. More production is considered as higher productivity. This is not necessarily true because to evaluate productivity is not from the output side only but by a comparison between how much the inputs go to the production and how much they generate the outputs. If the productivity measurement includes all input and outputs, then we obtain Total Factor Productivity (TFP). Measurement of the TFP growth (TFPG) needs (at least) two periods of time.

Fare et al. (1994) used a measurement technique of productivity by decomposing TFPG into changes in TE over time (catching up) and shifts in technology over time (innovation). These components describe the natural way to the identification of catching up and the innovation, respectively. The measurement is a geometric mean Malmquist productivity indexes by exploiting two distance functions from *t* period to *t+1* period. Higher productivity growth implies that the firm or organization is able to move their operation closer to frontier.

4.2 Model Specification

In the present study, we apply the DEA method with specification output oriented Malmquist index to measure efficiency and productivity growth of SMEs and LSEs in the Malaysian food processing industry. Data of one output and nine inputs for seven-years are used in the model. Output oriented efficiency measurement was selected because it is more realistic to assume the firms tend to maximize output at the given level of inputs rather than to minimize inputs to produce a given level of output.

4.2.1 Measurement of Efficiency and Productivity Using DEA

Efficiency and productivity are not a static measurement, but it change over time. It can be estimated by measuring the moving forward the distance function from the period of t_1 to the period of t_{1+1}. The concept of distance functions initially was developed by Sten Malmquist (Malmquist, 1953). The method decomposes TFP growth into two components namely technical efficiency change and technological change (Caves et al., 1982 and Fare et al., 1984).

Recent development of efficiency and productivity measurement uses varying types of outputs and inputs data in the model. For a non profit organization, sometimes the data is not in a currency unit, which is not suitable for a traditional method like price index number. In this condition, DEA has the advantage because of its flexibility to use non price input.

Model of DEA can be formulated by assuming *N* firms, each produce *M* outputs using *K* inputs. For all of i^{th} firms, we have $K \times N$ inputs matrix *X*, and $M \times N$ output matrix *Y*. If *u* is represented by the *M* x 1 vector output weight and *v* represents the *K* x 1 vector of input weight, for each firm or industry we have the ratio of all outputs over all inputs as $u'y_i/v'x_i$. Following Coelli et al. (2003), the optimum mathematical programming problem can be expressed as:

$$\text{Max}_{u,v}\ (u'y_i/v'x_i)$$
$$\text{s.t. } u'y_j/v'x_j \leq 1,\ \ j=1,2\ldots,N.$$
$$u, v \geq 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.7)$$

where *u* is *Mx1* vector of output weights and *v* is a Kx1 vector of input weights. The equation measures efficiency subject to the constraints and the value is maximum one and minimum zero. To find a finite solution, a condition $v'x_i = 1$, should be imposed to equation 4.7 :

$$\text{Max}_{u,v}\ (\mu'y_i)$$
$$\text{s.t. } v'x_i = 1$$

$\mu' y_j - \nu' x_j \leq 0, \; j = 1,2.., N.$

$\mu, \; \nu \geq 0,$ ………………………………………….……………...…… (4.8)

The equation 4.8 has been setting-up in many existing software of DEA to calculate efficiency level of a Decision Making Unit (DMU).

Refer to Wang and Schmidt (2002), a two stages analysis has been employed to investigate the determinants of TFPG of the Malaysian FPI. In the first stage, we employ DEA to measure efficiency and productivity growth, and in the second stage, we use tobit regression method to identify its determinants. The result of the DEA stands as dependent variables and the factors affecting productivity growth as independent variables (endogenous and exogenous).

Endogenous variables are variables generated within a model, which are determined by one of the functional relationships. However the exogenous variables are the variables, which are indirectly specified by the model. Exogenous variables are used for setting arbitrary external condition to get a more realistic model. In short, Baldani et al., (2005) noted that endogenous variables are determined within the solution of the model, while exogenous variables do not explicitly models their determination or derivation. In this study, the endogenous variables were obtained from the micro level data of each sub-industry, and exogenous independent variables come from macro level data (foreign direct investment, public infrastructure and average of world oil price stand for the proxy of energy price).

DEA is a methodology directed to frontiers rather than central tendencies (Seiford and Thrall, 1990). This method attempts to measure efficiency of DMUs or firms through linear programming techniques, which ‘envelop’ observed input – output vectors as tightly as possible (Boussofiane et al., 1991). Tubene (1997) argued that in using a series of optimization, DEA may provide a better fit model to each observation because the revealed technology is a closer estimate of the actual true technology underlying the data.

DEA is chosen in this study because of the following reasons. First, DEA is a major improvement over the translog index approach. The translog index approach is flawed since it ignores technical inefficiency and only calculates the technical change, which is inaccurately interpreted as TFP growth. Second, the DEA has some advantages over the stochastic frontier approach which calculates both EFCH and TECH as components of TFP growth. Third, one important advantage is that DEA envelopes observed input-output data without requiring a priori specification of functional forms. Different specifications of the production function under the parametric approach provide different results, and this is a serious methodological problem (Coelli et al., 2003; Senggupta, 2005 and Mahadevan, 2003).

However, DEA is not free from limitations. These limitations including (i) measurement error and statistical noise are assumed to be non-existent, (ii) it does not allow for statistical tests typical of the econometric approach, (iii) insensitive to any random shocks or data measurement errors because of lack a stochastic specification (Pitt and Lee, 1981).

4.2.2 Malmquist Productivity Index

Output Oriented Malmquist Index

The DEA method measures TFP growth base on input and output oriented of Malmquist Index (MI). In particular the MI is given by the proportions of value of distance function for two period of time (Fare et al., 1994). The output-oriented MI assumes that the maximum level of output (*y*) can be produced by a given level of input (*x*) using technology in period of *t*. Then the Malmquist productivity index (MI$^{t)}$ is defined as:

$$MI^t\left(y^{t+1}, y^t, x^{t+1}, x^t\right) = \frac{D_0^t\left(y^{t+1}, x^{t+1}\right)}{D_0^t\left(y^t, x^t\right)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.9)$$

where $D_0^t\left(y^{t+1}, x^{t+1}\right)$ and $D_0^t\left(y^t, x^t\right)$ are distance functions of the output based on the t+1 period of technology.

Accordingly, the Malmquist productivity index (MI^{t+1}) for period t+1, can be write explained as:

$$MI^{t+1}\left(y^{t+1},y^{t},x^{t+1},x^{t}\right)=\frac{D_0^{t+1}\left(y^{t+1},x^{t+1}\right)}{D_0^{t+1}\left(y^{t},x^{t}\right)} \qquad \text{………………..……….. (4.10)}$$

Where $D_0^{t+1}\left(y^{t+1},x^{t+1}\right)$ and $D_0^{t+1}\left(y^{t},x^{t}\right)$ are output distance function based on the t period of technology.

Referring to work of Fare et al., (1994), the geometric mean of the output-oriented MI for t and t+1 period can be derived as:

$$MI\left(y^{t+1},y^{t},x^{t+1},x^{t}\right) = \left[M^{t}\left(y^{t+1},y^{t},x^{t+1},x^{t}\right)\times M^{t+1}\left(y^{t+1},y^{t},x^{t+1},x^{t}\right)\right]^{1/2} \qquad \text{…. (4.11)}$$

Input Oriented Malmquist Index

Input oriented index focuses the minimization of input to produce a given level of output. Therefore, the Malmquist productivity index (MI^t) for the period t is given by

$$MI^{t}\left(y^{t+1},y^{t},x^{t+1},x^{t}\right)=\frac{D_i^{t}\left(y^{t+1},x^{t+1}\right)}{D_i^{t}\left(y^{t},x^{t}\right)} \qquad \text{……..………………………...... (4.12)}$$

where, $D_i^{t}\left(y^{t+1},x^{t+1}\right)$ and $D_i^{t}\left(y^{t},x^{t}\right)$ are the input distance function based on the t period of technology. The Malmquist productivity index (M^{t+1}) for period t+1 similarly can be formulated as

$$MI^{t+1}\left(y^{t+1},y^t,x^{t+1},x^t\right)=\frac{D_i^{t+1}\left(y^{t+1},x^{t+1}\right)}{D_i^{t+1}\left(y^t,x^t\right)} \quad \text{……………………..} \quad (4.13)$$

$D_i^{t+1}\left(y^{t+1},x^{t+1}\right)$ and $D_i^{t+1}\left(y^t,x^t\right)$ are the input distance functions based on the t+1 period of technology. For these two oriented Malmquist indexes, based on the technology of period t and t+1, the geometric mean can be defined as:

$$MI\left(y^{t+1},y^t,x^{t+1},x^t\right) = \left[MI^t\left(y^{t+1},y^t,x^{t+1},x^t\right) \times MI^{t+1}\left(y^{t+1},y^t,x^{t+1},x^t\right)\right]^{1/2} \quad \ldots \quad (4.14)$$

Equation (4.11) and (4.14) both output-oriented and input-oriented measures the productivity are technically different. However, if the technology in the period *t* and *t+1* exhibit returns to scale, then both indices will be same. According to Fare (1992) the Malmquist productivity index based on input approach can be decomposed into:

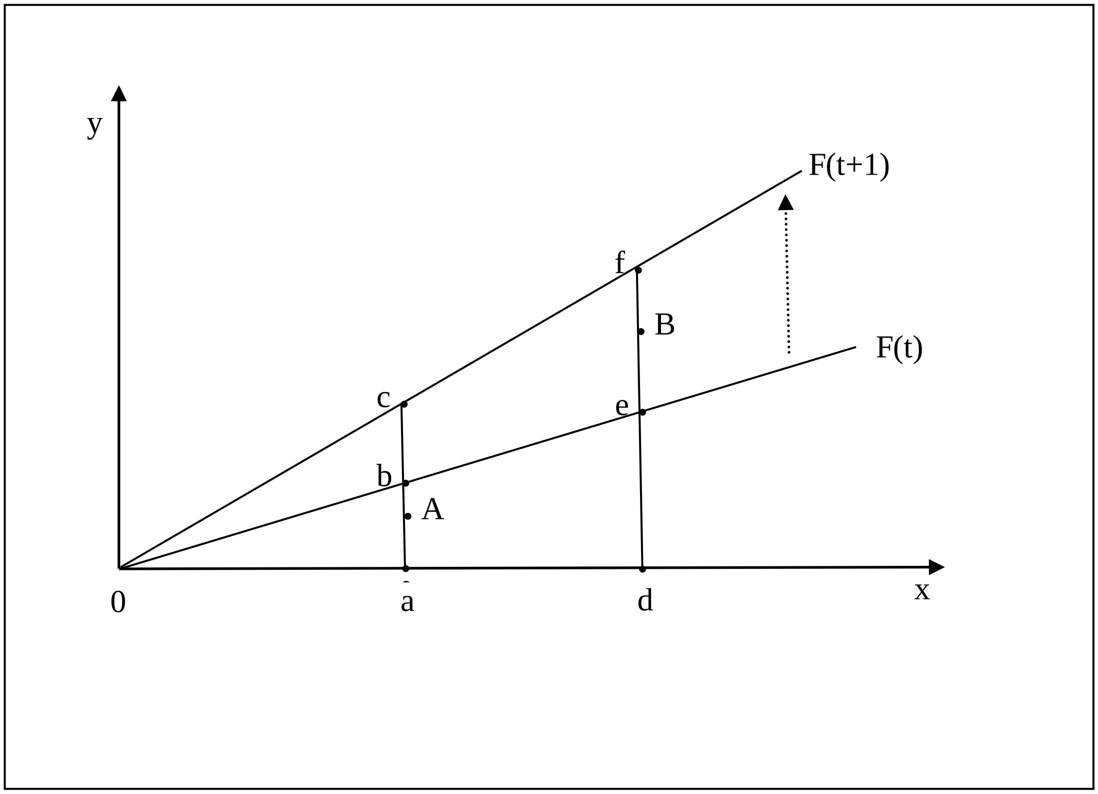
$$MI\left(y^{t+1},y^t,x^{t+1},x^t\right) = \left[MI^t\left(y^{t+1},y^t,x^{t+1},x^t\right) x MI^{t+1}\left(y^{t+1},y^t,x^{t+1,}x^t\right)\right]^{1/2} =$$

$$\underbrace{\frac{D_c^{t+1}\left(y^{t+1},x^{t+1}\right)}{D_c^t\left(y^t,x^t\right)}}_{\text{TE}}\underbrace{\left[\frac{D_c^t\left(y^{t+1},x^{t+1}\right)}{D_c^{t+1}\left(y^{t+1},x^{t+1}\right)} \times \frac{D_c^t\left(y^t,x^t\right)}{D_c^{t+1}\left(y^t,x^t\right)}\right]^{1/2}}_{\text{TP}} \quad \text{………………………} \quad (4.15)$$

Interpretation of the results for the above measurement is; for the value of productivity index is greater than one (MI > 1), then productivity did grow. However, if MI < 1 means the productivity is declining over time. The first part (outside bracket) is the change in efficiency and the following parts is the term measures technological change between period *t* and *t*+1. Assuming subscript c denotes a constant return to scale.

If the assumption is relaxed and allowed Variable Return to Scale (VRS), then the MI can decompose TFP growth into four components namely EFCH (technical efficiency change, PECH (pure efficiency change), SECH (scale efficiency change) and TECH (technical efficiency change). EFCH is the efficiency level of a firm getting closer to the frontier (catching-up). It defines the increment of output by using the same input or amount of reducing input at constant output. TECH depicts the shifting of the frontier itself which may be caused by employing new technology, new invention or automation. SECH is a ratio between TE_{crs} to $TE_{vrs,}$ means the level of the scale operating of a firm. A larger output (usually) is produced by a larger firm, so that the larger firms tend to have a higher SECH due to their operation is closer to the point $TE_{crs} = TE_{vrs}$. PECH is an efficiency measurement relative to the VRS technology; this is management impact efficiency.

A simpler explanation about concept of the Malmquist TFP index is depicted in Figure 4.4. It shows that the MI measurement is based on the geometric means of two distances function in the period t and t+1 respectively.



Source: Adopted from Coelli et al. (2003)

Figure 4.4 Concept of Malmquist Index

Suppose a particular firm is operating at the point A to produce *y* outputs by employing *x* inputs. In the period t, the production function of the firm: A = (y^t, x^t) and the firm forward his production to point B in the period t+1, B = (y^{t+1}, x^{t+1},). The possibility production frontier is given by F(t) and F(t+1) for the two periods respectively. The shifting of production from A to B within two periods of time (t and t+1) provide four distance functions; D^t (A) = aA/ab, D^{t+1}(A) = aA/ac, D^t (B) = dB/de and D^{t+1} (B) = dB/df, then we obtain:

$$MI^{t+1}(A,B)=\frac{dB/df}{aA/ab}\left[\frac{dB/de}{dB/df}\,\frac{aA/ab}{aA/ac}\right]^{1/2}=\frac{dB/df}{aA/ab}\left[\frac{df}{de}\,\frac{ac}{ab}\right]^{1/2} \quad \ldots\ldots\ldots\ldots\ldots \quad (4.16)$$

From this equation, it can be seen that the efficiency term captures the change in the distance from the frontier function in t and t+1, and the technological growth related to the geometric mean of the vertical movement of the frontier function from F(t) to F(t+1). Improvement of productivity over the period is expressed by the value of distance function greater than one, and decreasing productivity is expressed by the value less than one.

In this study, we assume the n^{th} DMUs, n = 1,2...N (number sub industry in the Malaysian FPI in five-digits MSIC), each produce y^{th} outputs by using x^{th} inputs. Data obtained from the annual survey of manufacturing industries in Malaysia conducted by the Department of Statistics, Malaysia for the period of 2000-2006.

4.3 Panel Data Analysis

In the present study we use panel data, which is collected from the annual survey of all sub industries in the Malaysian FPI during the period of 2000-2006. Panel data is a combination data of cross-sectional observation in a sequence of time. Data of the multiple objects such as people, firms and countries, were observed within at least two periods. If one has n sample objects with T time series, then he has n x T number of observations. The common model in panel data can be written as:

$$y_{it} = \alpha + X'_{it}\beta + u_{it} \qquad i = 1, \ldots N; t = 1, \ldots T \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.17)$$

where i is denoted as an observing individual (cross sectional) and t is denoted as time (time series), α is a scalar, β is K x 1 and X_{it} is the i^{th} observation on K explanatory variables. The component error u_{it} in the model for disturbance can be decomposed as:

$$u_{it} = \mu_i + v_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.18)$$

where μ_i is an unobservable individual specific effect and v_{it} is a reminder disturbance.

Recently panel data has been using widely in the economics studies due to some advantages. According to Baltagi and Kao (2000), the advantages of the panel data are:

(1) *able to control individual heterogeneity*. Within the data, it may occur some observations are individual invariant or time invariant. In cross sectional or time series analysis solution for the invariant data is omitting the specific observation from equation which may lead to a bias result of estimation,

(2) *gives more informative data, more variability, less collinearity, more degrees of freedom and more efficiency.* Problems such high collinearity among variables in time series can be less likely with combining the cross sectional dimensions that add the variability,

(3) *better to investigate the dynamics of adjustment.* For instance unemployment, job turn over, residential and income mobility. Panel data can estimate the proportion of the case in one period remain in other period,

(4) *better to perceive and calculate effects that are simply not recognizable in pure time series or pure cross sectional data.* For example in a particular year disaster happen in an area would consequence dropping the quantity of harvest and normal quantity for other year. It only panel data can be detected in this case,

(5) *allowable to establish and test more complicated behavioral models.* For example the dynamics growth of productivity and growth of efficiency is only can analysis using panel data, and

(6) *can eliminated bias from aggregation over individual.*

However, panel data is not free from the drawback such as difficulties in collecting data, distortion of measurement error, selectivity problem and short time series. Therefore, in analyzing the panel data, several tests and models have been developed by the statistician to ensure the result of estimation is unbiased, consistent and efficient. The test is necessary for such correction of non-zero mean of the t-statistic (unobserved heterogeneity) to confirm the properties of panel regression analysis.

4.3.1 Panel Unit Root Test

Panel unit root test is initiated to robust the power of test for long data (has a structural change problem) and cross sectional data (has heterogeneity problem). It is a statistical test for the hypothesis of a difference stationary time series against a trend stationary alternative. Initially, the test was most applicable to the time series data. However, since early 1990s; a unit root test has been applied to panel data (Hayakawa, 2010). Quah (1994) and Levin and Lin (1993) have had developed a unit root test for homogeneous panel.

Data has a unit root if the mean and variant of the data are in high fluctuation over time. Baltagi and Kao (2000) studied the purchase power parity of cross country data, argued that the parameter for panel data model can be divided into parameters of the interest and nuisance parameters (error component).

Suppose Y_t, is a dependent variable, then we can write a model of unit root test as:

$$Y_t = Y_{t-1} + u_t \text{ , } \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 4.19$$

where t is time and u is error estimation of time variant. However, estimation will be bias toward zero when α is less than but near to zero (Maddala, 1992). Many tests have developed by econometrician to correct this problem. One of the most popular models is Augmented Dickey Fuller (ADF) which was provided in much statistical software. Levin et al. (2002) designed a procedure to evaluate the null hypothesis that each observation in the panel has integrated time series against the alternative hypothesis that all individuals' time series are stationary.

The hypotheses are:

H_0 : $\rho = 0$ (*unit roots exist*, the variable is not stationer)

H_1 : $\rho \neq 0$ (there is no *unit roots*, the variable is stationer)

In case the result of analysis shows that the data has unit root, then to smooth non-stationary to a stationary data, following Gujarati and Porter (2009) one can use the *first difference test:*

$\Delta Y_t = (\rho-1)\,(Y_{it} - Y_{i,t-1})$ to make $\rho = 0$. …………………………………….. 4.20

$\Delta = ((Y_{it} - Y_{i,t-1}),$ called as first difference operator.

4.3.2 Fixed Effect and Random Effect Panel Analysis

Fixed Effect Model

In the panel data analysis, the terms fixed effects or random effects are related to how to treat the particular coefficients in a model as a fixed or as a random value. Fixed effects model controls the omitted variables that are differ between cases but constant over time. Changes in the variables over time can be used to estimate the effects of the independent variables on dependent variable. Fixed effect model is applicable for both random and non-random samples; however, the random effect models are usually appropriate only to the random samples.

If one is focusing on a specific set of N firms, then the fixed effect model is a suitable specification. In this case, unobservable individual specific effect (μ_i) is assumed to be a fixed parameter and remainder disturbance stochastic (v_{it}) are independent and identically distributed, iid $(0,\sigma_v^2)$. Following Baltagi and Kao (2000), the simple panel equation expressed as:

$$y_{it} = \alpha + X'_{it}\beta + u_{it} + v_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(4.21)}$$

divided by *t* to get:

$$\bar{y}_i = \alpha + \beta \bar{x}_i + \mu_i + \bar{v}_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(4.22)}$$

Subtracting these two equations and averaging all observations then:

$$\bar{y}_{..} = \alpha + \beta \bar{x}_{..} + \bar{v}_{..} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(4.23)}$$

Equation 4.30 known as fixed effect least square. Testing the fixed effect one can use hypotheses (using F test):

H_0: $\mu_1 = \mu_2 = \ldots\ldots = \mu_{N-1} = 0$

H_1: $\mu_1 \neq \mu_2 \neq \ldots\ldots \neq \mu_{N-1} \neq 0$

Random Effect Model

Random effect model is a suitable specification if we draw *i* = N individual from a large population. Since the inference made out of a large population, using fixed effect cause loss degree of freedom. The loss of degree of freedom due to many parameters in the fixed effect can be overwhelmed if the μ_i is assumed random. Random effects ignorance the disturbance terms when the dummy variables present and it is also called as error components model (ECM).

Gujarati (2009) defined the random effects model as:

$$y_{it} = \beta_{1i} + \beta_2 X_{it} + .. + \beta_n X_{it} + u_{it} \quad \ldots\ldots \quad (4.24)$$

where β_{1i} is assumed as a random variable with a mean value of β_1. Then the intercept for each i can be expressed:

$$\beta_{1i} = \beta_1 + \varepsilon_i \quad \ldots\ldots \quad (4.25)$$

where ε_i is a random error with zero mean and variance σ_ε^2. If the composite error $w_{it} = \varepsilon_i + u_{it}$, and each individual reflected in the error term ε_i then the equation 4.25 becomes:

$$\begin{aligned} y_{it} &= \beta_1 + \beta_2 X_{it} + .. + \beta_n X_{it} + \varepsilon_i + u_{it} \\ &= \beta_1 + \beta_2 X_{it} + .. + \beta_n X_{it} + w_{it} \quad \ldots\ldots \quad (4.26) \end{aligned}$$

The composite error w_{it} is not correlated with any of the independent variables in the model, but since εi stands as a component of w_{it} indirectly it has a correlation indeed and makes the result is inconsistent. Therefore, it was become a debate to use a fixed effect or random effect model. Statistically, the appropriate model can be determined by a kind of test. The common test is Hausman tes.

4.3.3 Hausman Test Specification

To find the fit model in the panel data analysis, whether it is fixed effect or random effect model, depends on the assumption and the likely correlation among the individual, error components, and explanatory variables. If no correlation between error and explanatory variable then a random effect model is a suitable model. However, when the error term and explanatory variable have a correlation then fixed effect model is better. Baltagi and Kao (2000) derived equation for Hausman test specification from comparing the $\hat{\beta}_{\text{GLS}}$ $\bar{\beta}_{\text{Within}}$ both consistent under the null hypothesis $E(u_{it}/X_{it}) = 0$. The equation is:

$$y^{*} = X^{*}\beta + \hat{X}\gamma + w_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.27)$$

where $y^{*} = \sigma_v \Omega^{-1/2}$ y, $X^{*} = \sigma_v \Omega^{-1/2} x$ and $\hat{X} = QX$ are used to test $\gamma = 0$.

4.4 Tobit Regression Analysis

Tobit regression model is a hybrid model from probit and multiple regressions. The model was, firstly, introduced by James Tobin (Tobin, 1958) in an article entitled "Estimation of relationship for limited dependent variables". He studied the household expenditure on varies luxurious commodity (new car). In that case, probit method is unsuitable due to desires to explain the value of non-limit response rather than the probability of the limit and non-limit responses only. To exclude a non-limit response is inefficient if the data is available. Then multiple regression method is an appropriate model if there were no concentration of observations at a limit, but the assumption is not realized. Based on this constraint, Tobin (1958) introduces a new alternative model now is known as a tobit regression model.

Comparing to the traditional regression method such as OLS, tobit model provides more efficient estimates of the parameters. In addition, it is more accurate to estimate the expected value of the dependent variable when the dependent variable is censored or truncated (Kinsey, 1981). It is common in the literature to investigate efficiency and productivity growth using DEA, and then use tobit analysis to find the determinants (see: Yu, 1998).

In some cases, it may occur that the range of the dependent variable is constrained or limited in some way (Greene, 2003). The limitation of dependent variable may be due to two conditions (i) censored (upper or lower limit) and (ii) truncated (missing data). Following to Amemiya (1973) and McDonal and Moffitt (1980) the general model of tobit method can be defined as:

$$y_t = x_t \beta + u_t, \qquad \text{if } X_t\beta + u_t > 0$$

$$= 0 \qquad \text{if } X_t\beta + u_t \leq 0$$

$$t = 1, 2, \ldots N \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.28)$$

N is a number of observations, y_t = dependent variable, X_t = a vector of explanatory variable, β = an unidentified coefficient and u_t = independently distributed error term assumed to be normal with zero mean and constant variant σ^2. The model assumes an underlying stochastic index equal to $X_t \beta + u_t$, and it will be estimated when the value is greater than zero.

The expected value of y in the model is:

$$Ey = X\beta F(z) + \sigma f(z) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.29)$$

Where $z = X\beta/\sigma$, $f(z)$ is the unit normal density and $F(z)$ is the cumulative normal distribution function. Then the expected value of y for observation above limit (say as y^*), is simply $X\beta$ plus the expected value of the truncated normal error term.

$$Ey^* = E(y|y>0)$$

$$= E(y|u> -X\beta)$$

$$= X\beta + \sigma f(z)/F(z) \tag{4.30}$$

From equations 4.28, 4.29 and 4.30 above, the basic relationship between *Ey* (the expected value of all observation) and *Ey** (the expected value conditional above the limit) and the probability of being above limit F(z), can be written as:

$$Ey = F(z)Ey^* \tag{4.31}$$

The effect of a change in the i^{th} independent variable *X* on *y* can be obtained from derivation function:

$$\partial Ey/\partial X_i = F(z)\,(\partial Ey^*/\partial X_i) + Ey^*(\partial F(z)/\partial X_i) \tag{4.32}$$

McDonald and Moffitt (1980) argued that the total change in *y* can be disaggregated into two very intuitive parts with a substantive and important economic implication: (i) the change in *y* of those above limits, weighted by the probability of being above the limit; and (ii) the change in the probability of being above the limit, weighted by the expected value of *y* if above.

By assuming that β and σ has been estimated, then each part of the equation (4.32) can be measured by mean of X's at some value of $X\beta$. From the equation (4.18) Ey^*

can be calculated and value of F(z) is available in statistical tables. Partial derivatives of cumulative normal distribution function on X_i can be calculated:

$$\partial F(z)/\partial X_i = f(z)\ \beta i/\sigma \quad \text{(4.33)}$$

And from equation (4.18),

$$\begin{aligned}\partial Ey^*/\partial X_i &= \beta_i + (\sigma/F(z))\partial f(z)/\partial X_i - (\sigma f(z)/F(z)^2)\ \partial F(z)/\partial X_i \\ &= \beta_i\ [1-zf(z)/F(z)-f(z)^2/F(z)^2] \quad \text{(4.34)}\end{aligned}$$

Effect of a change in X_i on y^* is not equal to β_i .

There are five components of output analysis of the DEA; Total Factor Productivity Change (TFPCH), Technical Efficiency Change (EFCH), Technological Change (TECH), Scale Efficiency Change (SECH) and Pure Efficiency Change (PECH). Each of this component stands as a dependent variable in the tobit regression model. Since the dependent variables dispense on positive and negative value, we make a censoring at the lower limit (zero). Using the conventional regression method like OLS gives a bias and inconsistent estimation. The more appropriate approach is tobit regression model (McDonald and Moffitt, 1980; Greene, 2003; and Dubin and River, 1989). We estimated the model using Stata Version 10 software, employing the normal probability distribution for the error term. The specification model is:

$$\ln TFPCH_{it} = \alpha + \beta_1 \ln RND_{it} + \beta_2 \ln TRAIN_{it} + \beta_3 \ln ITEXP_{it} + \beta_4 \ln GINF_{it} + \beta_5 \ln FDI_{it} + \beta_6 \ln OPEN_{it} + \beta_7 \ln WOILP_{it} + \beta_8 \ln UNIV_{it} + \beta_9 \ln NU_{it} + \beta_{10} \ln FOWE_{it} + U_{it} \quad \ldots\ldots (4.35)$$

(Note: Definition of these variables are presented in Table 4.2)

4.5 Variables and Data

We divided the Malaysian FPI into two groups, i.e. Small Medium Enterprises (SMEs) and Large Scale Enterprises (LSEs). This grouping is common in the industrial economic studies due to the significant gap in several aspects of each type. Difference in firm size, market orientation, technology, number or labor and ownership may be sources of bias if the SMEs and LSEs are analyzed jointly.

According to the Malaysia SMEs Corp., general definition of SMEs in manufacturing (including agro-based) is an enterprise with full-time employees not exceeding 150 or with an annual sales turnover not exceeding RM 25 million. Large Scale Enterprises defined which a firm has more than 150 employees and or annual sales turnover more than RM 25 million.

4.5.1 Dependent and Independent Variables

We have extracted the data to obtain one output and nine inputs as the variables for efficiency and productivity analysis. Output is the total value added in RM for each sub industry for one year, and inputs consist of; labor (number of worker), wages, total man working hours, total over time working hours, capital, material and energy (including water, electricity, fuel and gas). List of variables and definitions are shown in Table 4.1 and Table 4.2.

Table 4.1 Variables and the Definition for Measuring Efficiency and Productivity

Variables	Definition
Output	Total value added of each sub industry (RM)
Labor	Total number of worker (person)
Wage	Total amount paid to worker
Man hour working	Total working hour
Over time working	Over time working hour
Capital	Total asset (RM)
Material	Value of raw material purchased in particular year (RM)
Water	Total amount spent for water (RM)
Electicity	Total amount for electricity (RM)
Fuel and and gas	Total amount for fuel and gas (RM)

Source: The Department of Statistics, Malaysia (2008)

Table 4.2 Variables and the Definition for Analyzing the Determinants of TFPG

Variables	Symbol	Definition
Dependent Variables:		
Productivity (TFP) Growth and its components	TFPG	Change in total factor productivity in particular year relative to period t+1 based on current technology
Independent Variables:		
Training cost	TRAIN	Amount allocated to train staff and worker
R&D budget	R&D	Amount allocated for R&D (total for each sub industry)
IT expenditure	ITEXP	Amount allocated for Information and Technology (total for each sub industry)
Education level of worker	UNIV NU	Number of worker graduated from university and not graduated from university
Foreign Ownership	FOWE	Foreign ownership as dummy (existing foreign ownership=1, no foreign ownership=0)
Openness	OPEN	The ratio of total export and import to GDP (Sun et al., 1999; Ang, 2008; Anderson, 2001; Shiu and Hesmati, 2006)
Foreign Direct Investment	FDI	Total foreign direct investment for food processing industry
Public Infrastructure	GINF	Government expenditure for infrastructure
Energy price	WOILP	Average world oil price

Source: Calculation by using DEA method, the Department of Statistics, Malaysia (2008), MIDA (2008), MITI, OPEC Web site

4.5.2 Sources of Data

Data for the Malaysian FPI is obtained from the Department of Statistics Malaysia (DoS). The data is five-digit, referring to the new Malaysian Standard Industrial Classification (MSIC) which has been improved since 2000 following the standard international classification issued by FAO. Therefore, the latest data is consistently available from 2000 to 2006. To summarize, we describe the analysis in a flow chart of the conceptual framework as shown in the Figure 4.5.

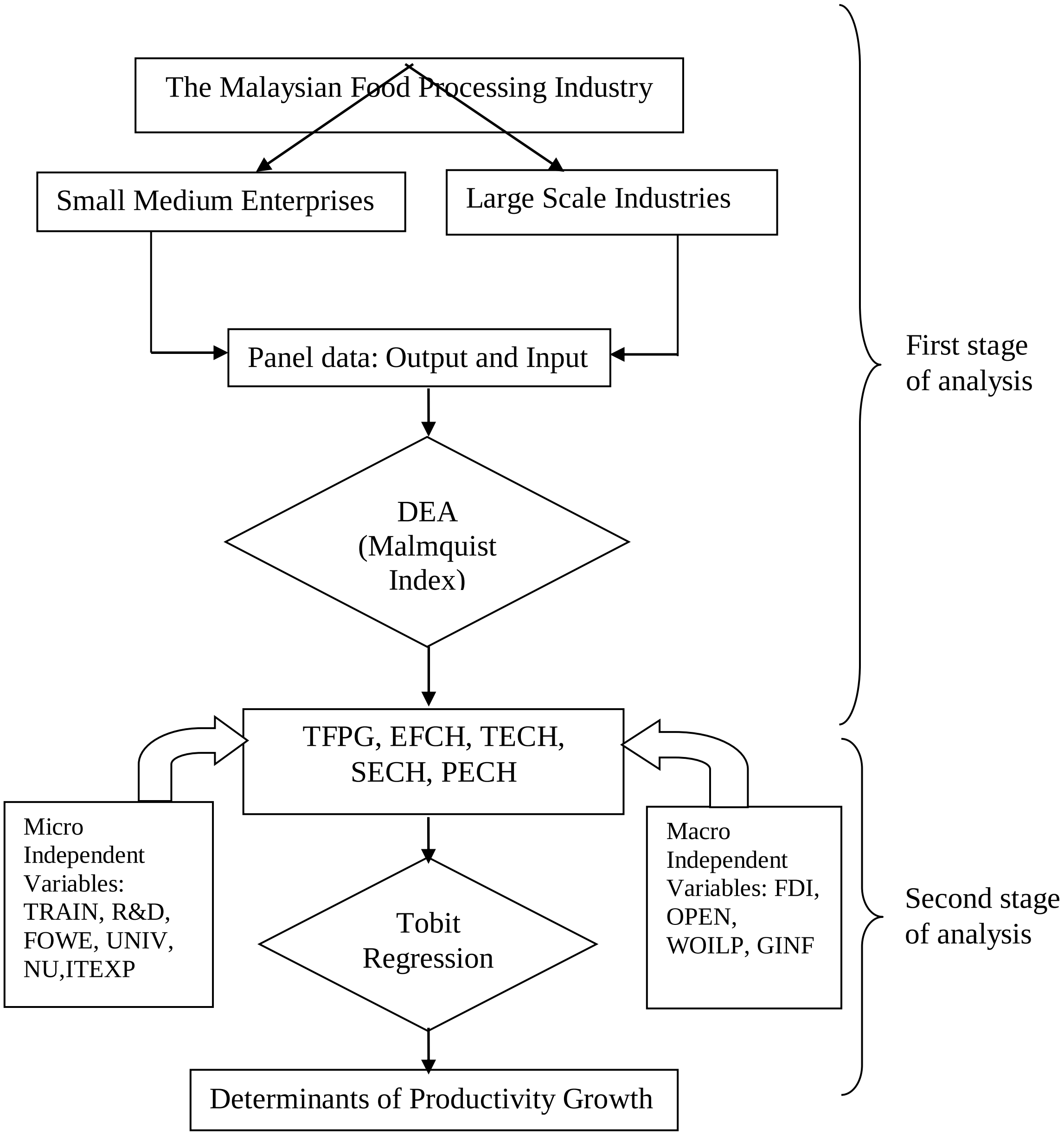


Figure 4.5 Flow Chart of the Conceptual Framework

CHAPTER 5

RESULTS AND DISCUSSION

This chapter presents results and discussions of the study done on the Small and Medium Enterprises (SMEs) and the Large Scale Enterprises (LSEs) in the Malaysian Food Processing Industry (FPI). The results presented in this chapter included input and output growth, efficiency, partial productivity and total factor productivity during the period of 2000-2006. The discussion concentrated mainly on the general performances and differences among sub-industries, as well as determinants of productivity growth.

5.1 Introduction

Malaysian FPI consists of 35 sub-industries under SME category and 27 sub-industries under LSE category. Referring to the Malaysian Standard Industrial Classification (MSIC), the industries are categorically placed under the code number 151 to 155. Detail of the sub-industries, with the name and their five digits codes, listed in the Table 5.1 for SMEs and Table 5.2 for LSEs. LSE has fewer numbers of sub-industries than the SMEs because only a few sub-industries in the LSE managed to attract large-scale investors. The eight sub-industries excluded from the LSE's list: 15141 (coconuts); 15311 (rice milling); 15319 (flour of other beans); 15322 (glucose, syrup and maltose); 15323 (sago, tapioca and starch); 15491 (ice); 15493 (tea) and 15495 (peanuts).

Table 5.1 Sub Industries in the SMEs of Malaysian Food Processing Industry

No.	Code	Sub Industry	ABBRE
1	15111	Processing and preserving poultry & poultry products	POULT
2	15119	Processing and preserving meat & other meat products	MEAT
3	15120	Processing and preserving fish and fish products	FISH
4	15131	Canning of pineapples	PINAP
5	15139	Canning and preserving fruits and other vegetables	FRVGT
6	15141	Manufacturing of coconut oil	CCNT
7	15142	Manufacturing of crude palms oil	PALMO
8	15143	Manufacturing of refined palm oil	RFPLM
9	15144	Manufacturing of palm kernel oil	KERNO
10	15149	Manufacturing of oil and fat from other vegetables	OOTVG
11	15201	Manufacturing of ice cream	ICECR
12	15202	Manufacturing of condensed, flour, other milk	MILK
13	15311	Rice milling	RICEM
14	15312	Flour milling (excluding sago and tapioca)	FLOUR
15	15319	Manufacturing of flour products of other beans	OTFLO
16	15322	Manufacturing of glucose, syrup and maltose	GLUC
17	15323	Manufacturing of sago, tapioca and others starch	STARCH
18	15330	Manufacturing of animal feed	FEEDS
19	15411	Manufacturing of biscuit and cakes	BISCU
20	15412	Manufacturing of bread, cake and other bakery	BREAD
21	15420	Sugar refinery	SUGAR
22	15431	Manufacturing of cocoa products	COCO
23	15432	Manufacturing of chocolate and sugar confectionary	CHOCO
24	15440	Manufacturing of macaroni, noodle & similar products	NOODL
25	15491	Manufacturing of ice (excluding dry ice)	ICE
26	15492	Manufacturing of coffee	COFFE
27	15493	Manufacturing of tea	TEA
28	15494	Manufacturing of spice and curry powder	SPICE
29	15495	Manufacturing of peanut and peanut products	PNUT
30	15496	Manufacturing of sauce and flavor include MSG	SAUCE
31	15497	Manufacturing of snack	SNACK
32	15499	Manufacturing of food other category	OTHER
33	15510	Alcohol from fermentation, drugs and wine	ALCHO
34	15541	Manufacturing of soft drink	SOFTD
35	15542	Processing of mineral water	MIWTR

Source: Adapted from Department of Statistics, Malaysia (2008)

Table 5.2 Sub Industries in the LSEs of Malaysian Food Processing Industry

No	Code	Sub Industry	ABBR
1	15111	Processing, preserving poultry & poultry products	POULT
2	15119	Processing, preserving meat & other meat products	MEAT
3	15120	Processing and preserving fish and fish products	FISH
4	15131	Canning of pineapples	PINAP
5	15139	Canning and preserving fruits and other vegetables	FRVGT
6	15142	Manufacturing of crude palms oil	PALMO
7	15143	Manufacturing of refined palm oil	RFPLM
8	15144	Manufacturing of palm kernel oil	KERNO
9	15149	Manufacturing of oil and fat from other vegetables	OOTVG
10	15201	Manufacturing of ice cream	ICECR
11	15202	Manufacturing of condensed, flour, other milk products	MILK
12	15312	Manufacturing of flour (excluding sago & tapioca)	FLOUR
13	15330	Manufacturing of animal feed	FEEDS
14	15411	Manufacturing of biscuit and cakes	BISCU
15	15412	Manufacturing of bread, cake and other bakery products	BREAD
16	15420	Sugar refinery	SUGAR
17	15431	Manufacturing of coco products	COCO
18	15432	Manufacturing of chocolate and sugar confectionary	CHOCO
19	15440	Manufacturing of macaroni, noodle & similar products	NOODL
20	15492	Manufacturing of coffee	COFFE
21	15494	Manufacturing of spice and curry powder	SPICE
22	15496	Manufacturing of sauce and flavor include MSG	SAUCE
23	15497	Manufacturing of Snack	SNACK
24	15499	Manufacturing of food other category	OTHER
25	15510	Alcohol from fermentation, drugs and wine	ALCHO
26	15541	Manufacturing of soft drink	SOFTD
27	15542	Processing of mineral water	MIWTR

Source: Adapted from Department of Statistics, Malaysia (2008)

Here, is the synopsis of each of the successive section in this chapter. Section 5.2 of this chapter discusses the trend of the output and input in the Malaysian FPI. Next, section 5.3 discusses production behavior in the Malaysian food processing industry, encompassing the partial factor productivity analysis. Section 5.4 probes into the technical efficiency of the Malaysia FPI using non parametric approach. Section 5.5 focuses the discussion on the productivity growth over the period of observation and its varying degree of differences among the sub-industries and between the SMEs and the LSEs. Finally, section 5.6 discusses the determinants of productivity growth in the Malaysian FPI.

5.2 Output and Input Growth

The main discourse of this section is to gain an in-depth knowledge on the output and input trend of the Malaysian FPI, which varies over time and among different sub-industries. The trend and variation of the output and input are critical factors for the unveiling of the efficiency and productivity change of Malaysian FPI, which will be the focal point of discussion in the later section.

5.2.1 Output and Input Growth in the SMEs

Firms in the SMEs, for the most part, supply their products to the local market or produce intermediate inputs to even larger manufacturer. It is not easy for small firms to enter the international market because of some restrictive factors such as the complexity of marketing channel, the term of payment, the high standard of product quality and the existing competition with other foreign producers. The SMEs should adhere to the safety standards for food production or any other requirements imposed by the importing country before entering foreign markets. The SMEs need to have their production facility upgraded, their use of technology optimized and their standard operating procedures updated, in order to meet Hazard Analysis Critical Control Point (HACCP) standards. HACCP is a set of standards recognized internationally for guaranteeing the safety of food products. The local industries are vulnerable and susceptible to the impact of globalization, which make them unable to compete in the export market. This scenario forces the local industries to perform efficiently with a high-productivity operation.

At the industrial level, the growth of output and input in the food manufacturing sector is closely linked to the growth of the firm establishment. In 2006, the number of establishment of the SMEs was 4,546 firms, represented a share of 97 percent from the total number of firms established. Contrastingly, the share of their output was only 52 percent from the total FPI output and only 50 percent for value added. Five sub-industries with the highest value added were companies involved in the manufacturing of crude palm oil, refined palm oil, alcohol, animal feed, and bread, cake and bakery products (The Department of Statistic, Malaysia, 2006) .

Table 5.3 shows the average of gross output, value added, labor, wages, capital, and material in the SMEs of Malaysian FPI for the period of 2000-2006. The value of gross output jumped over 50 percent during the period, from RM 26,938 million in 2000 to RM 45,081 million in 2006 with annual growth of 8.86 percent. On the other hand, value added recorded diminutive increase during the same period. In 2000, it recorded a value of RM 5,017 million and in 2006 a value of RM 6,354 million. The average growth of value added stood at 4.25 percent per annum.

Number of labor employed in the SMEs of the Malaysian FPI fluctuated over the period of observation. Declining trends in labor force participation, in the SMEs of the Malaysian FPI, observed during two distinct periods, i.e., from 2000 to 2001 and 2003 to 2004. Overall, labor force had negative growth of 3.67 percent per annum. The declining trend can be further illustrated by studying the fluctuation in number of establishment during the period of 2000-2006. Number of establishment in 2000 stood at 3,141, and the number has increased to 4,682 in 2006.. Value of wages has increased by 3.13 percent and the amount of wages paid to employee increased from RM 1,192 million in 2000 to RM 1,445 million in 2006. A consistent increased in the material purchase observed during the period of 2000-2006. In 2000, the material purchase figure stood at RM 18,825.7 million and the figure almost double in 2006 to RM 34,174.2 million. The average growth of the material purchase was 11.91 percent per annum. Material is the most crucial input for the food processing industry because more than 70 percent of the total cost of input goes to material purchasing. Although the input growth is somewhat fluctuated, the increase in material expenditure portrays the industry growing input consumption.

Table 5.3 Average of Output, Value Added and Inputs in the SMEs of Malaysian Food Processing Industry, 2000-2006 by Year

Year	Gross Output (000)	Value Added (000)	Labor	Wage (000)	Capital (000)	Material (000)
2000	26,937,756	5,016,816	162,918	1,192,333	7,044,930	18,825,697
2001	23,244,136	5,687,280	80,266	1,053,065	6,008,677	14,735,593
2002	33,358,728	4,415,494	86,995	1,198,807	7,251,727	25,396,349
2003	36,966,890	4,511,240	86,466	1,266,797	6,648,356	28,770,788
2004	36,372,193	5,353,312	82,581	1,245,832	7,529,254	27,293,200
2005	38,225,789	5,861,277	97,725	1,416,137	8,366,788	28,110,383
2006	45,080,666	6,354,014	101,090	1,445,159	8,895,311	34,174,214
Growth %)	8.86	4.25	-3.67	3.13	4.05	11.91

Source: Department of Statistics, Malaysia, 2006

Table 5.4 Average of Output, Value Added and Inputs in the SMEs of Malaysian Food Processing Industry, 2000-2006 by Sub Industry

Sub Industry	Gross Output (000)	Value Added (000)	Labor	Wage (000)	Capital (000)	Material (000)
POULT	108,413	13,176	505	6,618	19,546	84,418
MEAT	120,464	22,306	867	11,213	60,238	73,710
FISH	777,063	119,080	5,216	51,403	155,545	555,239
PINAP	18,201	3,404	158	2,069	8,524	6,746
FRVGT	139,709	29,335	966	13,090	43,152	70,911
CCNT	47,773	4,822	269	2,812	6,117	38,728
PALMO	17,172,751	2,125,026	27,101	392,971	3,128,628	13,919,488
RFPLM	3,015,879	145,441	1,168	36,139	238,023	2,675,974
KERNO	2,329,564	152,659	1,168	31,118	252,218	1,694,203
OOTVG	854,356	106,163	905	20,418	121,228	599,371
ICECR	135,659	38,910	936	16,389	73,805	42,869
MILK	188,865	27,811	399	9,539	95,921	114,456
RICEM	1,331,056	145,649	4,267	59,914	425,580	1,039,121
FLOUR	641,245	114,962	2,436	35,504	252,401	439,873
OTFLO	73,694	15,562	413	6,241	22,093	43,283
GLUCO	34,814	7,377	198	4,883	10,169	16,494
STARCH	64,018	11,044	632	7,234	31,518	36,457
FEEDS	2,507,749	267,937	3,476	82,098	335,710	2,042,108
BISCU	194,332	50,025	3,100	27,396	103,650	90,912
BREAD	762,912	234,653	12,253	115,978	318,425	363,639
SUGAR	13,082	3,625	174	1,803	4,705	6,837
COCO	504,897	50,306	542	11,974	104,871	412,983
CHOCO	237,646	62,073	1,716	27,401	113,580	96,097
NOODL	343,803	87,494	3,735	36,891	150,058	188,118
ICE	167,397	83,850	3,344	44,176	116,008	8,665
COFFE	251,523	62,266	1,779	26,025	104,234	126,065
TEA	61,259	14,544	389	4,893	69,718	35,650
SPICE	85,537	19,654	724	9,917	43,679	49,675
PNUT	73,466	14,812	487	6,116	12,248	45,918
SAUCE	100,286	29,043	383	9,797	56,423	40,445
SNACK	201,981	52,758	2,276	19,873	96,731	82,767
OTHER	587,709	169,692	5,037	68,973	277,781	257,339
ALCHO	171,864	98,526	353	8,854	55,342	46,773
SOFTD	542,007	101,051	2,031	31,279	149,888	221,748
MIWATR	49,178	13,038	387	4,850	42,202	10,548

Source**:** Department of Statistics, Malaysia (2006)

The most dominant sub-industries in the SMEs of the Malaysian FPI, were the manufacturing of crude palm oil, refined palm oil, kernel palm oil, rice milling and animal feed (Table 5.4). They were the most dominant sub-industries because of their high generation of output and high consumption of input. These five sub-industries, combined, contributed an overwhelming figure of 77.73 percent to the total output of the SMEs. Low gross output observed in these sub-industries: sugar refinery, canning of pineapples, manufacturing of glucose, manufacturing of coconut oil and processing of mineral water. In terms of labor absorption, a larger proportion of labor employed by the sub-industries: manufacturing of crude palm oil, manufacturing of bread, cake and other bakery, processing and preserving fish and fish products, manufacturing of food other category and rice milling. The facts and figures presented suggested that the palm oil industry (crude, refined and kernel palm oil) was the most prominent sub-industry in the Malaysian FPI. Currently, Malaysia placed second rank after Indonesia as the largest producer of palm oil in the world. These two countries, combined, made up about 85 percent of world palm oil production. Therefore, in the Malaysian FPI, the palm-related industries are the most significant in terms of value-added contribution, employment and national income generation.

Figure 5.1 illustrates the trend of output and input growth for the SMEs. There is a relatively similar trend between the output and all the inputs with the exception of the value added. High growth of output and inputs observed from 2001 to 2002 then the growth had ups and downs the following years. In 2006, the value of output and material increased at the same time the value added, capital, wage and employment decreased. The fluctuation in growth of output and inputs presumably is the direct impact of the economic contraction after the financial crisis that engulfed East Asian economies in 1997/1998. Even after the massive financial crisis many of the world's economies continued experiencing the pressure of economic downturn when energy price soared to an all-time high in 2005.

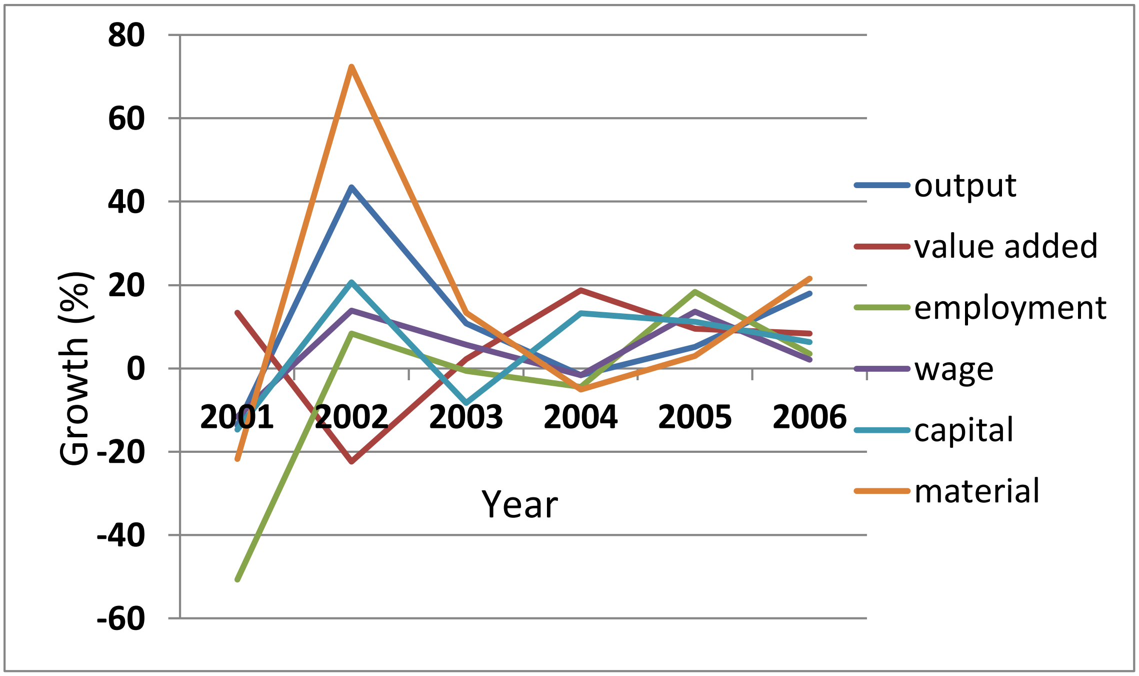


Figure 5.1 Growth of Output, Value Added and Factor Input in the SMEs

Employment in the manufacturing sector suffered the worst in 2001 when the number of worker employed in the industry dropped by 50.3 percent. The industry recovered marginally from the setback in 2002 when it recorded an increase of 8 percent in the employment growth. However, agro-based industries seem to handle the crisis better than the rest of other industrial sectors during that period. Agro-based industries showed some resilient during and after the crisis. Overall, from 2005 to 2006 the industries showed positive growth of both output and material but showed a declining trend in labor, capital and wage. The trend as illustrated in Figure 5.1 showed an improvement of labor and capital productivity in the SMEs of Malaysian food processing industry.

5.2.2 Output and Input Growth of LSEs

The average number of establishment of the Large Scale Enterprises (LSEs), in the Malaysian FPI, during 2000-2006 was 136 firms. This represented only three percent of total firms in the industry. However, their contribution was about 48 percent of the total of FPI outputs. The share to the value added was 50 percent, and share to the employment was 30 percent. The major players in the LSEs are mostly operating as a multinational company such as Néstle, Fraser & Neave, Yeo Hiap Seng, Mamee-Double Decker, Lam Soon Berhad, Clouet & Co., and Danone.

Table 5.5 shows the average of the gross output, value added, labor, wages, capital and material in the LSEs of Malaysian FPI during 2000-2006. The value of gross output doubled from RM 19,447 billion in 2000 to RM 43,084 billion in 2006 at annual average growth of 15.5 percent. LSE's growth in the output, value added, labor, capital and material was greater than that of the SME's. Most of the large-scale enterprises apply automation in their production, which is capital intensive, rather than labor intensive as in the SMEs. Although both the LSEs and SMEs generated an equivalent value added, the LSEs employed only about a quarter of labor compare to the number employed by the SMEs. From the total work force of 202,616 working under the Malaysian FPI, about 80.4 percent employed in the SMEs and the remaining 19.6 percent employed by the LSEs. Both the SMEs and the LSEs had average labor growth of -3.67 and 19.6 percent per annum, respectively.

In terms of labor wage, as much as 60.7 percent of the total amount RM 1,961.45 million, has been paid to the workers in the SMEs and the remaining 39.3 percent paid to the workers in the LSEs. This is a suggestive evidence to say that the LSEs pay higher wages for their labor than the SMEs. Overall, growth of other inputs in the LSEs is greater than in the SMEs.

Table 5.5 Average of Output, Value Added and Inputs in the LSEs of Malaysian Food Processing Industry, 2000-2006 by Year

Year	Gross Output (000)	Value Added (000)	Labor	Wage (000)	Capital (000)	Material (000)
2000	19,447,269	2,436,784	39,698	769,115	4,955,879	14,080,046
2001	20,967,129	3,578,876	42,007	842,925	5,114,606	14,289,487
2002	23,951,285	3,777,638	42,703	892,015	5,582,777	16,948,133
2003	29,930,452	3,540,907	45,783	910,282	5,472,226	22,871,565
2004	35,296,475	3,776,315	49,753	994,354	6,379,654	27,310,200
2005	40,332,975	4,631,958	56,688	1,203,258	7,452,066	30,514,997
2006	43,084,623	4,820,726	55,217	1,249,326	7,269,948	32,393,570
Growth	15.5	21.3	19.6	14.4	13.7	16.5

Source: Department of Statistics, Malaysia (2006)

Table 5.6 presents the average output and inputs of sub-industries in the LSEs of Malaysian food processing industry. Among the most dominant sub-industries in the LSEs were the manufacturing of refined palm oil, crude palm oil, and kernel palm oil, manufacturing of condensed, flour, other milk products, sugar refinery, manufacturing of oil and fat from other vegetables and alcohol from fermentation, drugs and wine. They were dominant industries due to their high gross output and value added. Total output of these seven sub-industries, combined, accounted for 75 percent of the total output of the LSEs. In contrast, lower outputs observed in the sub-industries involved in the canning of pineapples, manufacturing of ice cream and coffee. Firm’s ability to generate the output and allocate the inputs affects the firm performance in terms of efficiency and productivity growth. The table presents the comparison of productivity of one input between the sub-industries in the LSEs. For example, POULT (poultry) and RFPLM (refined palm oil) employed relatively same number of labor, but the output and value added of these two industries were markedly different. The same occurrence also existed in other sub-industries such as between SAUCE and ALCHO, and MEAT and SUGAR. Labor-intensive industries are those which employ a large number of labors for their operation.

Table 5.6 Average of Output, Value Added and Inputs in the LSEs of Malaysian Food Processing Industry, 2000-2006 by Sub Industry

Sub Industry	Gross Output (000)	Value Added (000)	Labor	Wage (000)	Capital (000)	Material (000)
POULT	617,532	103,019	2,885	51,084	196,111	420,453
MEAT	362,023	45,904	1,890	27,504	80,952	254,648
FISH	778,619	142,293	4,242	47,960	176,596	511,004
PINAP	46,860	10,059	420	5,500	22,762	16,513
FRVGT	101,321	19,157	560	7,624	31,116	54,369
PALMO	6,519,929	559,078	5,474	82,200	825,535	5,649,080
RFPLM	8,829,514	337,647	2,848	68,144	688,888	7,915,889
KERNO	1,293,388	55,897	526	17,550	149,339	1,242,042
OOTVG	1,089,674	79,168	1,263	30,286	212,199	827,775
ICECR	93,496	29,530	592	12,286	69,442	26,453
MILK	2,533,526	478,545	3,851	150,021	599,132	1,365,103
FLOUR	696,541	160,685	1,102	41,291	346,329	458,996
FEEDS	315,953	32,847	449	10,963	50,168	257,955
BISCU	495,878	133,898	3,827	54,950	255,004	189,250
BREAD	427,471	109,252	2,795	40,716	262,607	179,513
SUGAR	1,740,914	302,346	1,855	56,413	257,563	1,201,560
COCO	654,244	76,771	612	16,600	142,271	515,573
CHOCO	396,520	114,186	2,063	41,325	226,588	168,075
NOODL	331,314	81,583	1,675	32,579	141,992	155,391
COFFE	75,398	17,607	489	5,461	20,576	39,722
SPICE	211,768	47,493	1,285	22,724	124,673	118,071
SAUCE	235,916	68,923	893	22,930	131,452	94,872
SNACK	308,271	84,775	1,632	26,430	188,506	106,423
OTHER	757,980	213,964	1,583	50,306	362,074	375,773
ALCHO	1,265,535	945,132	858	41,773	359,993	104,297
SOFTD	898,825	139,132	1,534	43,146	347,284	436,465
MIWATR	114,749	30,423	904	11,317	98,473	24,613

Source: Department of Statistics, Malaysia (2006)

Figure 5.2 depicts the growth of output, value added and major inputs of the LSEs in the Malaysian FPI during the period of 2001-2006. Large variation showed by the material purchase in 2000 and 2003. From 2001 until 2003, output showed steady increased and then it showed a declining trend for three consecutive years. The labor wage and number of employment showed consistent positive growth until 2005.

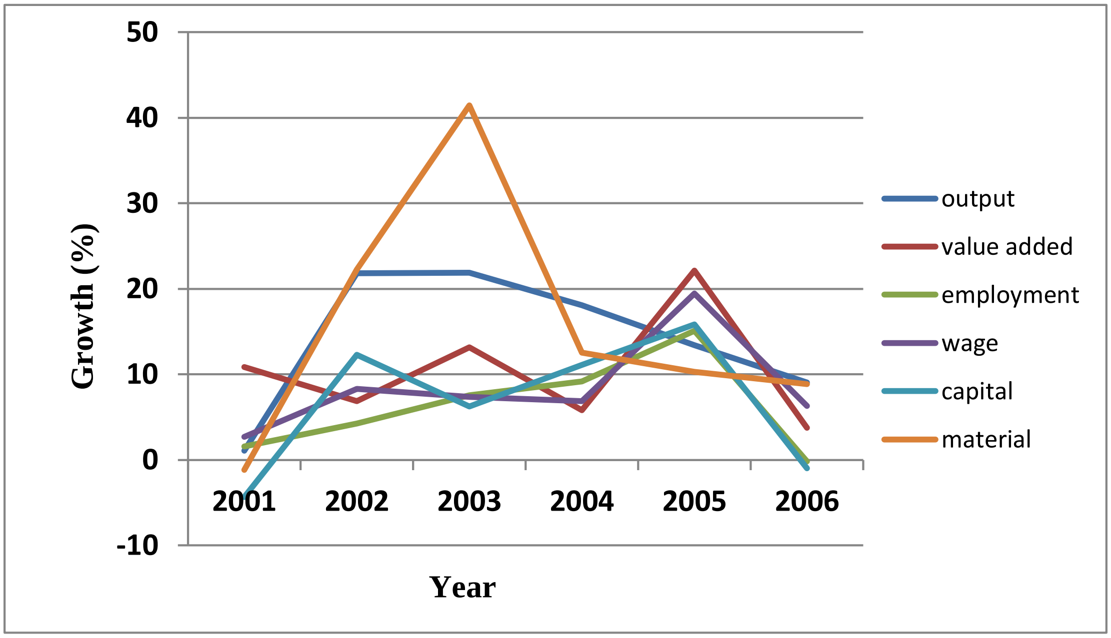


Figure 5.2 Growth of Output, Value Added and Factor Input in the LSEs

5.3 Partial Factor Productivity

This section discusses the production behavior in the Malaysian FPI, encompassing the partial factor productivity analysis. As discussed in chapter three, partial productivity is a basic measurement, and yet it is a useful concept for analyzing and comparing the productivity level of every input between firms or industries. Partial factor productivity analysis is useful in providing initial clue that enables the decision maker to investigate the implication of productivity level on the management. It is also used as a benchmarking tool for analyzing the competitor (Holman et al., 2008). In the present study, we analyze the productivity of main inputs, i.e., labor, capital and material.

5.3.1 Partial Productivity in the SMEs

Partial productivity discloses information about how a single input contributes to generating output in production. At the same time, it disregards all other contribution from other inputs. It also distinguishes how each input contributes to generating output in production. Partial productivity is a concept identical to the concept of marginal physical products. The marginal physical products proclaim that engaging one additional input promotes changes in the output.

Traditionally, there are three factors inputs used for partial productivity analysis in the manufacturing sector namely labor, capital and material. Labor productivity defines as valued added per unit of labor input (VA/L) and cost of labor defines as the cost of wages paid to workers per worker (W/L). Labor productivity explains the contribution of one unit of labor to generate output; it can be measured at the company level, production process level or national level. However, the increase of labor productivity is possibly in pursuant to more intensive use of other inputs, i.e., capitals or material. For example, the output increases pursuant to new investment in automation, which causes the production to produce higher output per unit labor. As a matter of fact, the essence of higher output, in this case, is the effect of higher investment in the capital or higher capital intensity. Therefore, labor productivity does not provide a complete evaluation of the overall productivity in the production process. However, the partial productivity is a simple measurement and interpretation. It helps the decision maker see the trend of time variant input.

Table 5.7 presents labor cost and partial productivity in the SMEs of Malaysian FPI during 2000 until 2006. The average annual partial productivity of the SMEs varied over time with the exception of the capital productivity. Labor cost and labor productivity increased from 13.65 to 14.03 with an average of 14.03. Increasing labor cost means that the company paid a higher wage to the employee, and it also reveals a better welfare for the workers. In contrast to the decreasing trend of labor forces as showed in Table 5.3, labor productivity appeared to show an increasing trend over the years. Overall, results of this study showed labor productivity was higher than the result showed by the previous research by Alias Radam (2007). In that study, he reported that the labor cost and labor productivity of Malaysian FPI was 11.6 and 46.65 respectively.

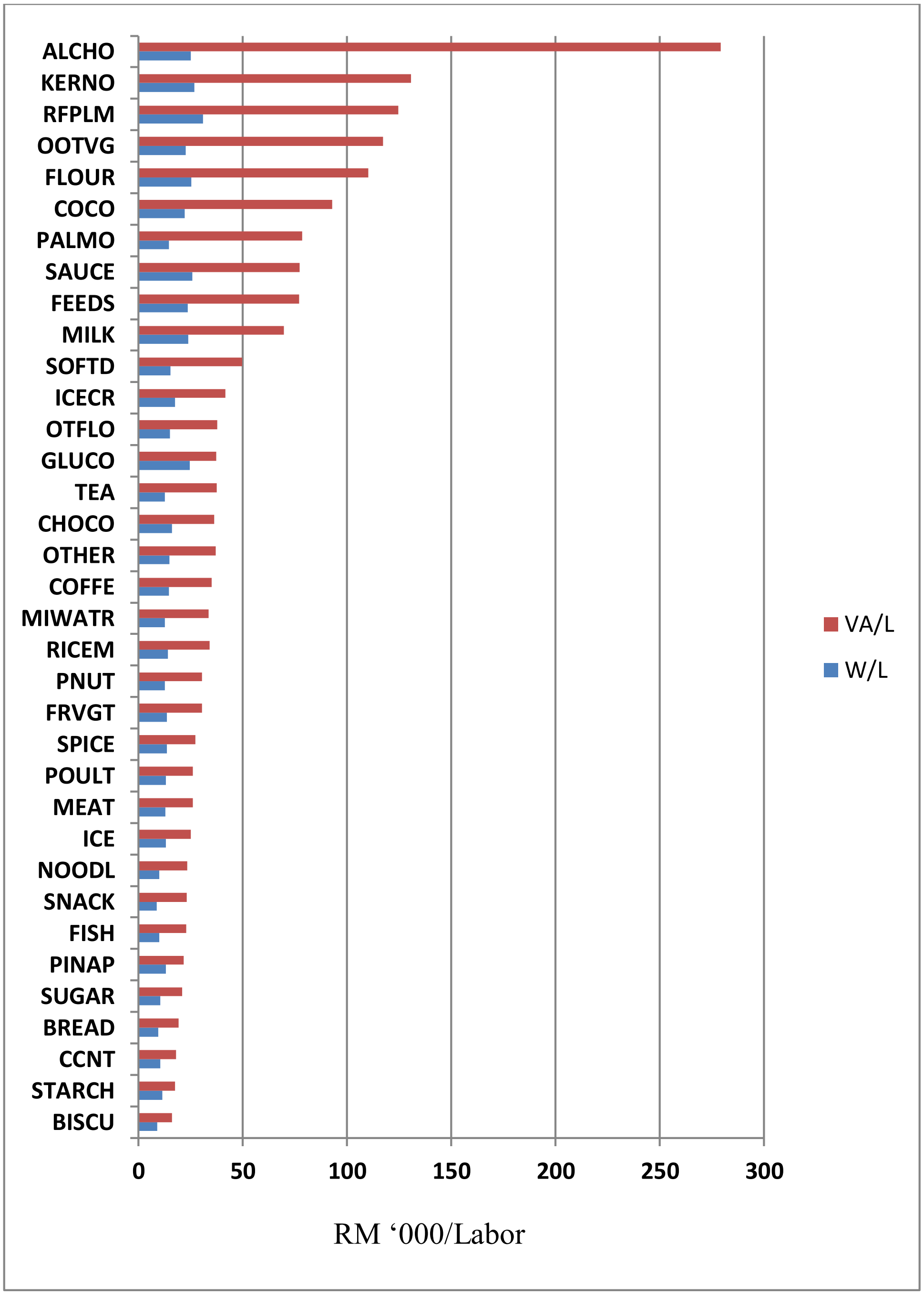
Table 5.7 Labor Cost and Partial Factor Productivity in the SMEs of Malaysian Food Processing Industry, 2000-2006

Year	Labor cost (W/L)	Labor productivity (VA/L)	Capital Productivity (VA/K)	Material Productivity (VA/M)
2000	13.65	47.05	0.60	0.22
2001	13.42	45.03	0.59	0.22
2002	13.68	50.31	0.61	0.17
2003	14.52	52.67	0.70	0.16
2004	14.67	54.83	0.63	0.17
2005	14.30	50.59	0.61	0.17
2006	13.95	54.48	0.67	0.16
Mean	14.03	50.71	0.63	0.18

Source: Calculated data from Department of Statistics, Malaysia (2006)

Capital productivity was relatively unchanged during the period of observation. This was congruent with the average growth (4.05 percent) of the total amount spent on capital, which stood at RM 7.045 billion in 2000 and RM 8.895 billion in 2006. A declining productivity trend appeared in the material usage. In 2000, the material productivity (value added per material) was 0.22 and in 2006, stood at 0.18. Low material productivity may indicate the low-material efficiency or a high proportion of material went to waste.

Figure 5.3 shows labor productivity (VA/L) and labor cost (W/L) for each sub-industry in the SMEs Malaysian FPI. The figure manifests the non-existence of a significant different of labor cost (W/L) among sub-industries in the SMEs. In contrast, the labor productivity (VA/L) varied among industries. Higher cost of labor observed in the manufacturing of alcohol, palm oil, refined palm oil, palm kernel oil and in the manufacturing of sauce. Sub-industries with higher labor productivity were the manufacturing of alcohol, palm kernel oil, refined palm oil, flour and manufacturing of oil from other vegetables. Figure 5.3 shows that the industries with higher labor productivity tend to have a higher cost of labor. This phenomenon may be due to the firms gaining higher revenue, and the revenue distributed to all stakeholder, including their worker.



VA/L = Labor productivity,   W/L = Cost of labor

Figure 5.3 Labor Productivity and Cost of Labor per Employee in the SMEs

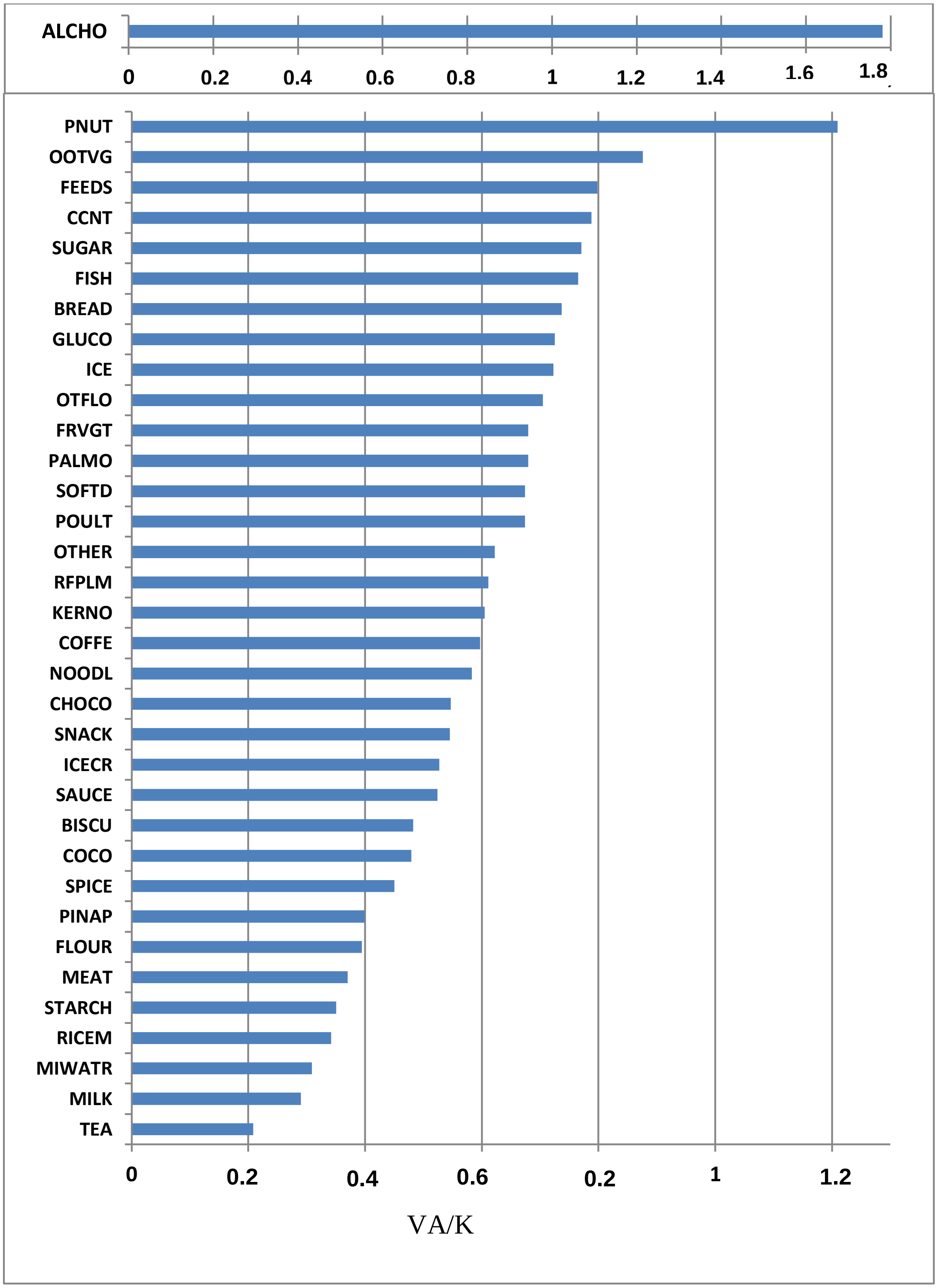


Figure 5.4 Capital Factor Productivity in the SMEs

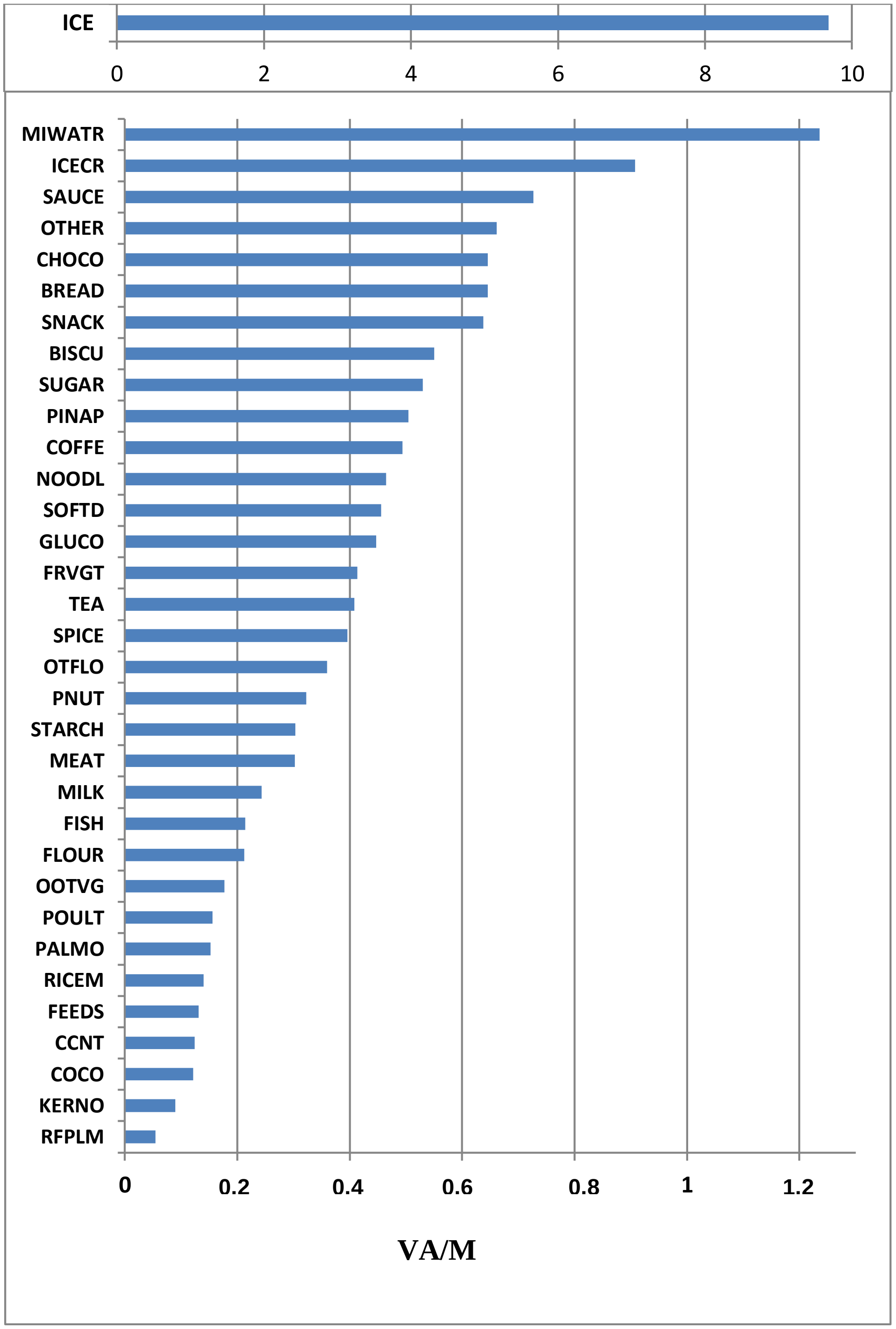


Figure 5.5 Materials Factor Productivity in the SMEs

Figure 5.4 shows capital productivity in the SMEs of Malaysian FPI. Capital productivity (value added per capital) reveals ability of industry to generate value added per unit capital. The capital productivity value in the SMEs varied with the lowest being 0.21 for the manufacturing of tea and the highest being 1.9 for alcohol from fermentation, drugs and wine industry. Five sub-industries with high capital productivity: manufacturing of alcohol from fermentation, drugs and wine, manufacturing of peanut and peanut products, oil from other vegetable, manufacturing of feeds and manufacturing of coconuts oil and coconut products. Five sub-industries with low capital productivity were manufacturing of tea, manufacturing of condensed and milk products, processing of mineral water, rice

Materials productivity of the SMEs in the Malaysian FPI is presented in Figure 5.5. Materials productivity depicts amount of value added produced per unit cost of materials. Materials productivity ranges from 0.054 to 9.676. Five sub-industries with high material productivity were manufacturing of ice, manufacturing of alcohol from fermentation, processing of mineral water, manufacturing of ice cream and manufacturing of sauce. The manufacturing of ice had an outstanding material productivity because this industry consumes abundant and relatively cheap raw materials. Sub-industries with low material productivity were manufacturing of refined palm oil, manufacturing of palm kernel oil, coco, coconuts and manufacturing of feed.

5.3.2 Partial Factor Productivity in the LSEs

Table 5.8 presents labor cost and labor productivity of the LSEs. Overall, LSEs had greater labor cost and labor productivity than SMEs as shown in Table 5.7. During the period of observation, labor cost for the LSEs displayed fluctuating trend. The labor cost value stood at 19.37 in 2000 and 22.63 in 2006, an increase of 16.83 percent. The labor cost showed an increasing trend during 2000 to 2003, and 2004 to 2006, but decreasing trend from 2002 to 2003. In contrast, labor cost for the SMEs did not show any significant changes. In 2000, the figure stood at 13.65 and 13.93 in 2006. Labor productivity average was 79.61 for the LSEs and 50.71 for the SMEs. However, capital productivity and material productivity were relatively the same between the SMEs and the LSEs.

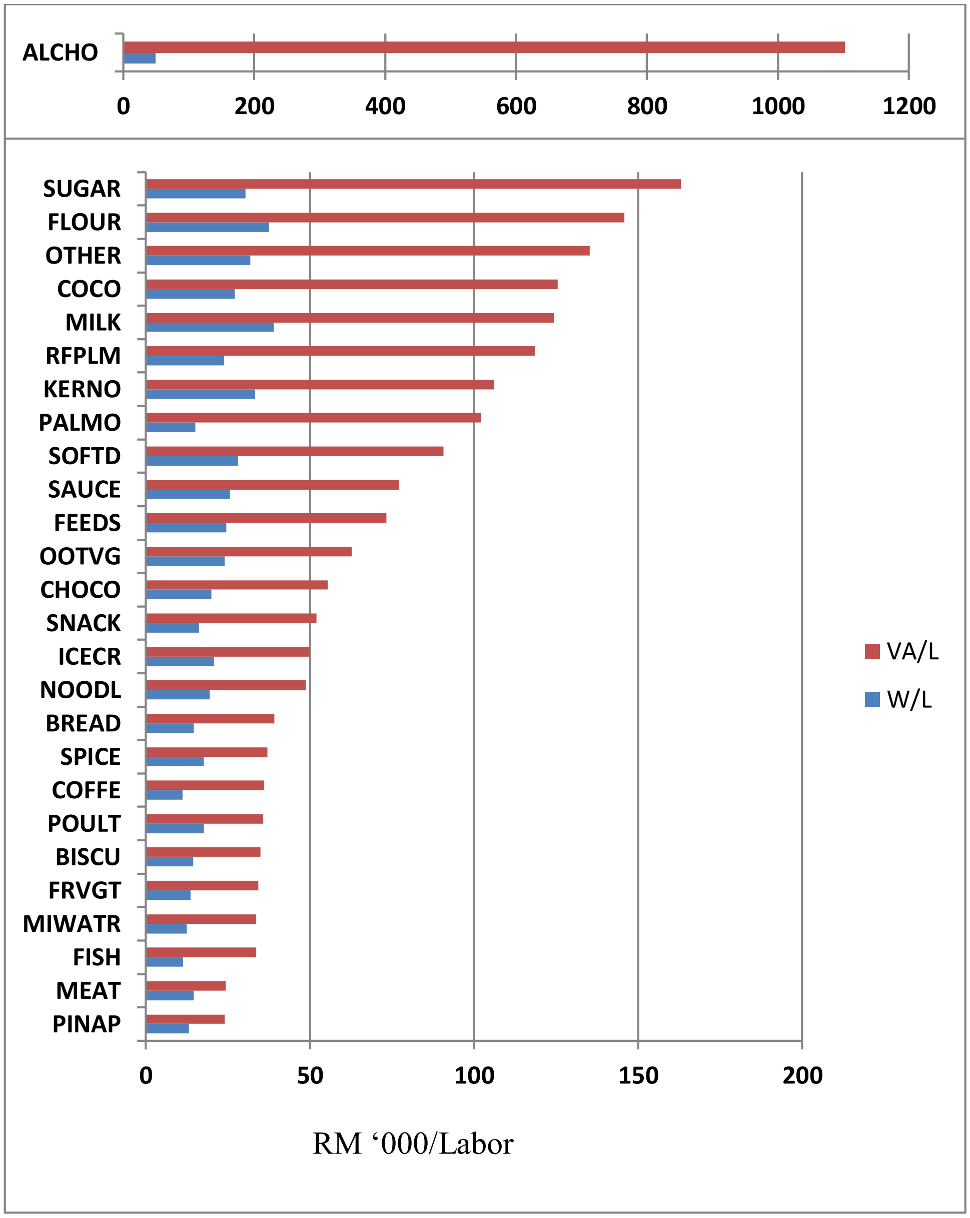
Labor productivity can serve many purposes. It reveals not only information about the ability of one unit of labor to produce output but also a tool to evaluate the quality of the labor forces. The impact of management efforts like training, learning by doing and improvement in enumeration theoretically caused higher labor productivity. Labor cost and labor productivity for each industry in the LSEs are presented in Figure 5.6. Figure 5.7 showed tabulation of capital productivity and Figure 5.8 shows materials productivity for each industry in the LSEs.

Table 5.8 Labor Cost and Partial Factor Productivity in the LSEs of Malaysian Food Processing Industry, 2000-2006

Year	Labor cost (W/L)	Labor Productivity (VA/L)	Capital Productivity (VA/K)	Material Productivity (VA/M)
2000	19.37	61.38	0.49	0.17
2001	20.07	85.20	0.70	0.25
2002	20.89	88.46	0.68	0.22
2003	19.88	77.34	0.65	0.15
2004	19.99	75.90	0.59	0.14
2005	21.23	81.71	0.62	0.15
2006	22.63	87.31	0.66	0.15
Mean	20.58	79.61	0.63	0.18

Sources: Calculated data from Department of Statistics, Malaysia (2006)

Figure 5.6 shows labor productivity and labor cost in the LSEs of Malaysian FPI. Observation to each industry discloses that manufacturing of alcohol and wine from fermentation (ALCHO) is an industry which has highest labor productivity. However, in term cost of labor no significant difference was found. Five industries have high labor productivity are manufacturing of ALCHO, manufacturing of other food products (OTHER), manufacturing of tapioca and flour products (FLOUR) and sugar refinery (SUGAR). The low labor productivity are pineapple, meat, fish mineral water and fruit-vegetable.



VA/L = Labor productivity,   W/L = Cost of labor

Figure 5.6 Labor Productivity and Cost of Labor per Employee in the LSEs

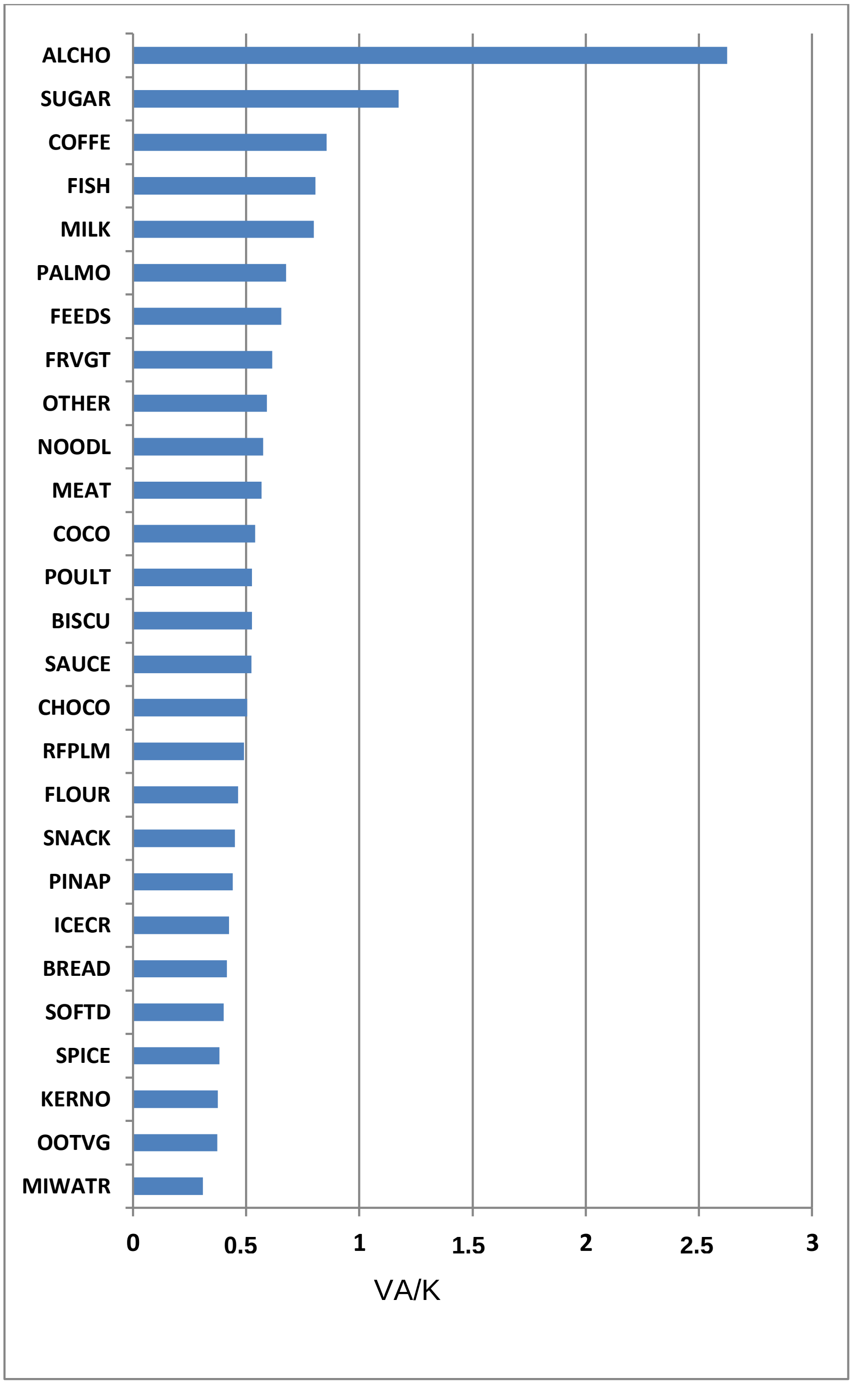


Figure 5.7 Capital Factor Productivity in the LSEs

0.4

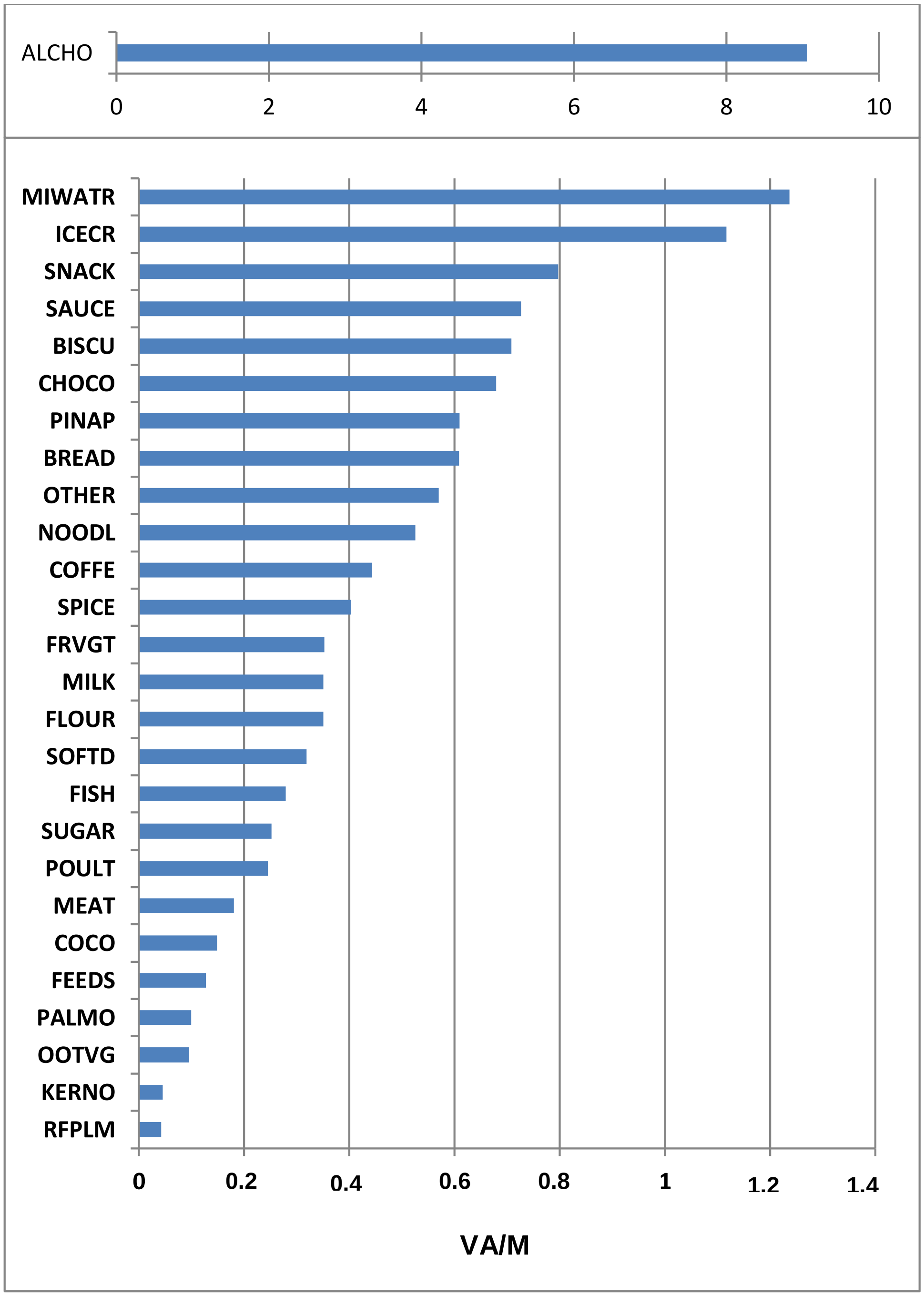


Figure 5.8 Materials Factor Productivity in the LSEs

0.4

As illustrated in Figure 5.7, capital productivity in the LSEs of Malaysian FPI has no significant difference among industries except for ALCHO. Labor productivity was in the range of 0.31 up to 2.63. Five sub industries have a high capital productivity were ALCHO, SUGAR, COFEE, FISH and MILK. Higher capital productivity means the industry able to produce value added more than produced by other industry by using the same amount of capital. The lowest capital productivity was found in the industry of mineral water (MIWTR), manufacturing of oil from other vegetable (OOTVG), manufacturing of palm kernel oil (KERNE), manufacturing of spice (SPICE) and manufacturing of softdrink (SOFTD).

Material productivity of LSEs in the Malaysian FPI is presented in Figure 5.8. As performed in capital productivity, industry ALCHO shows highest material productivity. Five industries have high material productivity were ALCHO, MIWTR, manufacturing of ice cream (IICECR), manufacturing of snack (SNACK) and manufacturing of sauce (SAUCE). The low material productivity were found in the industry of manufacturing of refined palm oil (REPLM), manufacturing of palm kernel oil (KERNE), manufacturing of oil from other vegetable (OOTVG), manufacturing of crude palm oil (PALM) and FEEDS. Over all, the industries have a higher partial productivity (capital, material and labor) tend to have a higher labor cost as per illustrated from above three figures. Particularly industry ALCHO, although it has very high material and capital productivity, value of labor cost (amount paid to labor) was not congruent to this partial productivity.

5.4 Technical Efficiency

In the previous section, the focus of the investigation was on the input-output growth and partial productivity conducted on both the SMEs and LSEs of Malaysian Food Processing Industry. In this section, the focus shifted to the technical efficiency of the Malaysia FPI. The investigation used non parametric approach as already discussed in chapter 4.

5.4.1 Technical Efficiency in the SMEs

Efficiency and productivity are two key indicators for management to evaluate the firm or organization performance. The management goals are usually achieved by companies with higher efficiency and productivity. The firms remain in the market because they produce competitive products. Technical Efficiency (TE) divulges all the best practices of the production process of a firm relative to the virtual maximum efficiency created by data model of all firms in the industry. On the other word, it is operating close to the frontier.

Table 5.9 shows the scores and the growth of TE in the SMEs of Malaysian FPI for the period of 2000-2006. Based on Constant Return to Scale (CRS) technology, average score of TE in the SMEs is 0.756 (75.6 percent). This score is higher than TE of the food manufacturing sector in Spain which recorded the score of 0.44 percent as reported by Marcos and Gavez (2000).

Based on Variable Return to Scale (VRS) technology, TE records higher score at an average of 0.945 (94.5 percent) during the period of observation. The divergences of both TE scores exist because of the different base of measurement. The CRS efficiency measurement weighs against the linear possibility production function (PPF) of a decision-making unit which may form a longer distance to the PPF. Tthe VRS weighs against a nonlinear PPF which forms a closer distance to function as discussed in chapter 4. Referring to the CRS technical efficiency, the SMEs of Malaysian FPI have the potential to increase the output by 24.6 percent.

Growth of the TE fluctuated over the years. CRS technical efficiency had positive average growth of 0.602 percent and VRS technical efficiency had negative growth of 0.570 percent per year. The time trend showed the TE experiencing a declining trend starting from 2001 and reaching the lowest score of 69 percent in 2003. Encouraging improvement of TE occurred from 2003 to 2004 where it recorded a score of 79.4 percent. The TE score, once again, declined in the following years and recorded a score of 73.4 percent in 2006.

Table 5.9 Technical Efficiency in the SMEs of Malaysian Food Processing Industry, 2000-2006

Year	**CRTS**		**VRTS**	
	TE	**Growth**	**TE**	**Growth**
2000	0.725	-	0.970	-
2001	0.795	9.655	0.938	-3.299
2002	0.779	-2.013	0.959	2.239
2003	0.690	-11.425	0.919	-4.171
2004	0.794	15.072	0.935	1.741
2005	0.777	-2.141	0.960	2.674
2006	0.734	-5.534	0.935	-2.604
Mean	**0.756**	**0.602**	**0.945**	**-0.570**

Source: Calculated data using DEA method

The finding from this study was consistent with the TE score obtained by Zahid and Mokhtar (2007), which stood at 72.9 percent, for the SMEs of Malaysian's food industries. From the theoretical framework, the TE score showed a nonlinear trend over the years could be attributed to the ability of a firm to catch-up with its production frontier was highly influenced by the management practice (controllable factor) and exogenous factor (uncontrollable factor). Organization best practices such as fewer rejected products, low quantity of waste, on time delivery, good quality of input, effective promotion and employing the more skilled workers are factors that can be controlled by management. Factors, which are uncontrollable by the management, include economic downturn, demand trend, interest rate, and inflation. These two factors, combined, influenced the ability of a firm to catch-up its outer boundary of the production function, where the calculation of TE took place.

Table 5.10 presents technical efficiency, for every sub-industry, of the Malaysian FPI during the period 2000-2006. There were five sub-industries experiencing full technical efficiency (TE equal to unity), i.e., the manufacturing of refined palm oil, kernel palm oil, animal feed, soft drink and alcohol from fermentation, drugs and wine. As per illustrated in Chapter 4 (Section 4.1.2), one decision making unit (DMU) technically is fully efficient if the DMU is operating at the frontier production curve. The frontier production function is formed from a bunch of data from other DMU. By observing growth of output and input (DOD, 2006) these industries show a significant growth in generating value added. In contrast, five sub-industries experiencing low technical efficiency were the manufacturing of crude palm oil, canning of pineapple, sugar refinery, manufacturing of glucose and manufacturing of syrup and maltose.

TE score in the SMEs of Malaysian FPI varied between 35.9 percent and 48.1 percent. This study employed aggregate data of each sub-industry. Therefore, it was not able to disclose the contribution of each existing firm in the industry to the TE score. For instance the lowest TE score of palm industry, this is resulted from an aggregate data of the same sub industry. However, TE score at the industry level is useful for evaluating the problems faced by firms in the industry.

Table 5.10 Technical Efficiency in the SMEs of Malaysian Food Processing Industry, 2000-2006 by Sub Industry

No.	Code	Industry	Year							
			2000	2001	2002	2003	2004	2005	2006	MEAN
1	15111	POULT	0.188	0.900	0.739	0.264	0.806	1.000	1.000	0.700
2	15119	MEAT	0.423	0.668	1.000	1.000	1.000	0.733	1.000	0.832
3	15120	FISH	1.000	1.000	1.000	1.000	1.000	1.000	0.849	0.978
4	15131	PINAP	0.207	0.352	0.567	0.176	0.691	0.358	0.163	0.359
5	15139	FRVGT	0.712	0.616	1.000	1.000	1.000	1.000	0.686	0.859
6	15141	CCNT	0.386	0.571	0.296	0.351	0.345	0.505	0.910	0.481
7	15142	PALMO	0.014	0.193	0.291	0.150	0.043	0.230	0.238	0.166
8	15143	RFPLM	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
9	15144	KERNO	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
10	15149	OOTVG	1.000	1.000	1.000	1.000	0.699	1.000	0.573	0.896
11	15201	ICECR	1.000	1.000	1.000	1.000	1.000	0.738	0.953	0.956
12	15202	MILK	1.000	0.221	0.633	1.000	1.000	1.000	0.478	0.762
13	15311	RICEM	0.907	1.000	0.460	1.000	1.000	1.000	1.000	0.910
14	15312	FLOUR	1.000	1.000	1.000	0.270	1.000	0.486	1.000	0.822
15	15319	OTFLO	0.434	0.605	0.469	0.610	0.387	0.359	0.360	0.461
16	15322	GLUC	0.531	1.000	0.808	0.035	0.079	0.353	0.109	0.416
17	15323	STARCH	1.000	0.307	0.545	1.000	0.633	0.923	0.328	0.677
18	15330	FEEDS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
19	15411	BISCU	0.559	1.000	0.659	0.592	0.648	0.538	0.698	0.671
20	15412	BREAD	1.000	1.000	1.000	0.911	1.000	1.000	0.780	0.956
21	15420	SUGAR	0.483	0.469	0.355	0.264	0.173	0.534	0.553	0.404
22	15431	COCO	0.440	0.758	0.647	0.278	1.000	1.000	0.999	0.732
23	15432	CHOCO	0.708	0.528	0.779	0.767	1.000	0.537	0.644	0.709
24	15440	NOODL	0.926	1.000	0.666	0.723	1.000	0.686	1.000	0.857
25	15491	ICE	0.783	1.000	1.000	0.996	1.000	0.802	1.000	0.940
26	15492	COFFE	1.000	0.949	0.989	1.000	1.000	0.865	0.573	0.911
27	15493	TEA	1.000	0.422	0.492	0.170	0.286	1.000	0.435	0.544
28	15494	SPICE	0.426	0.547	0.399	0.350	1.000	0.612	0.595	0.561
29	15495	PNUT	0.664	1.000	0.945	0.625	1.000	0.620	0.453	0.758
30	15496	SAUCE	0.379	1.000	0.845	0.336	0.231	1.000	0.484	0.611
31	15497	SNACK	0.954	0.765	0.659	0.729	0.769	0.835	1.000	0.816
32	15499	OTHER	1.000	1.000	1.000	1.000	1.000	0.685	1.000	0.955
33	15510	ALCHO	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
34	15541	SOFTD	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
35	15542	MIWATR	0.257	0.971	1.000	0.505	1.000	0.796	0.816	0.764

Source: Calculated data using DEA method

5.4.2 Technical Efficiency in the LSEs

Technical efficiency of the LSEs can be observed from Table 5.11. The average TE scores were 0.683 and 0.952 based on constant return to scale (CRS) and variable return to scale (VRS) respectively. There was a difference proportion of sub-industry with high technical efficiency under CRS measure and VRS measure. Large proportion of firms operating in high TE was under VRS with only a few with high TE score under CRS. In DEA concept, the formation of frontier function was from a collective data of firms or all sub-industries. Part of the industries may be operating close to the frontier, while others operating a distant away from the frontier. Therefore, it is preferable during the analysis TE score to put focus on a decision-making unit (DMU) rather than a group of firms or industries.

Table 5.11 Technical Efficiency in the LSEs of Malaysian Food Processing Industry, 2000-2006

Year	CRTS		VRTS	
	TE	Growth	TE	Growth
2000	0.636	-	0.931	-
2001	0.650	2.201	0.945	1.504
2002	0.700	7.692	0.973	2.963
2003	0.686	-2.000	0.943	-3.083
2004	0.576	-16.035	0.945	0.212
2005	0.754	30.903	0.949	0.423
2006	0.785	4.111	0.979	3.161
MEAN	**0.683**	**4.479**	**0.952**	**0.863**

Source: Calculated data using DEA method

During the period of observation, both CRS and VRS based measurement applied in the analysis. The TE showed an increasing trend from 0.636 in 2000 to 0.785 in 2006 for CRS and from 0.931 to 0.979 for VRS.

Table 5.12 shows the TE score of LSEs of the Malaysian FPI for the period 2000-2006 by sub industry. The sub-industries experiencing TE score equal to one or full technical efficiency: manufacturing of palm oil, refined palm oil and sugar refinery. Low TE score found in the industry: canning of pineapple, canning and preserving fruits and other vegetables, manufacturing of animal feed, sauce and flavor include MSG, and coco products. For these lower efficient sub-industries, policy maker should investigate the alternative strategy for development and its comparative advantage. Some of the industries do face heavy constraint in their daily operation. For example, the sub-industry involved in the processing of cocoa beans, the constraint of decreasing land for cultivation affected the domestic supply of raw cocoa beans. It means encouraging import cocoa beans is a much better solution rather than encouraging the opening of new domestic farming.

Table 5.12 Technical Efficiency in the LSEs of Malaysian Food Processing Industry, 2000-2006 by Sub Industry

No.	Code	Industry	Year							Mean
			2000	2001	2002	2003	2004	2005	2006	
1	15111	POULT	1.000	0.583	0.655	0.831	0.276	0.351	0.920	0.659
2	15119	MEAT	0.097	0.701	1.000	0.650	0.141	1.000	1.000	0.656
3	15131	FISH	0.578	0.726	0.860	1.000	1.000	0.713	0.716	0.799
4	15131	PINAP	0.825	0.097	0.155	0.192	0.586	0.637	0.081	0.368
5	15139	FRVGT	0.474	0.190	0.163	0.163	0.230	0.988	0.546	0.393
6	15142	PALMO	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
7	15143	RFPLM	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
8	15144	KERNO	0.760	1.000	1.000	1.000	0.220	1.000	1.000	0.854
9	15149	OOTVG	0.278	0.059	0.617	1.000	0.633	0.563	1.000	0.593
10	15201	ICECR	0.715	0.177	0.158	0.168	0.175	1.000	1.000	0.485
11	15209	MILK	1.000	1.000	0.936	1.000	0.845	1.000	1.000	0.969
12	15312	FLOUR	0.644	0.980	1.000	1.000	0.602	0.937	1.000	0.880
13	15330	FEEDS	0.608	0.096	0.235	0.293	0.308	1.000	0.307	0.407
14	15411	BISCU	0.415	1.000	0.441	0.455	0.387	0.670	0.585	0.565
15	15412	BREAD	0.233	1.000	0.539	1.000	0.642	0.449	0.444	0.615
16	15420	SUGAR	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
17	15431	COCO	0.479	0.208	0.257	0.247	0.211	1.000	0.937	0.477
18	15432	CHOCO	0.669	0.702	0.658	0.726	1.000	0.417	0.699	0.696
19	15440	NOODL	0.310	0.811	0.810	0.523	0.347	0.439	1.000	0.606
20	15492	COFFE	0.605	0.222	1.000	0.534	0.306	1.000	1.000	0.667
21	15494	SPICE	0.770	0.656	0.515	0.522	1.000	0.497	0.916	0.697
22	15496	SAUCE	0.709	0.732	0.127	0.168	0.170	0.388	0.861	0.451
23	15497	SNACK	0.258	0.656	0.768	0.522	0.518	1.000	0.496	0.603
24	15499	OTHER	0.343	1.000	1.000	0.839	0.802	1.000	0.616	0.800
25	15510	ALCHO	1.000	1.000	1.000	1.000	1.000	0.006	1.000	0.858
26	15541	SOFTD	0.399	0.841	1.000	0.700	1.000	0.795	0.717	0.779
27	15542	MIWATR	1.000	0.108	1.000	1.000	0.164	0.497	0.346	0.588

Source: Calculated data using DEA method

5.5 Total Factor Productivity Growth

There were significant differences between the SMEs and the LSEs in the FPI such as in the management practices, ownership structure, technology, and their market orientation. The characteristics of the SMEs, mostly family owned with basic management system, traditional technology and local oriented market. In contrast, the LSEs are capital intensive, complex management system, applied high technology and sell their products not only in domestic but to global market. These differences exist in all other economic sectors and consider being typical phenomenon. Therefore, the performance of these two groups may differ even they are using same inputs and produce the same output. It is vital to understand the TFP growth, since the surviving economic agent in the free competition market is the firm showing positive productivity growth. In this section, the focus of the discussion will be on the productivity growth over the years, and its varying trend among the sub-industry, and the differences between the SMEs and the LSEs.

5.5.1 Total Factor Productivity Growth in the SMEs

Total factor productivity growth (TFPG) is measured by the change of ratio inputs to the output in production during the period of observation. The investigation of the efficiency and productivity growth was started with the analysis of a pooled data of each sub-industry in the Malaysian FPI. The analysis used DEA method and Malmquist Productivity Index (MI) as discussed in section 4.3 and 4.4. A decision-making unit (DMU) has positive growth if the index is greater than unity and has negative growth if the index is less than unity. DEA decomposes the TFPG into four components; technical efficiency change, technological change, scale efficiency change and pure efficiency change. Table 5.13 shows the summary of Malmquist index of the SMEs in the Malaysian food processing industry.

Table 5.13 Summary of Malmquist Index in the SMEs of Malaysian Food Processing Industry, 2000-2006

Year	EFCH	TECH	PECH	SECH	TFPCH
2001	1.212	0.895	0.968	1.252	1.085
2002	0.999	0.833	1.031	0.969	0.832
2003	0.766	1.549	0.933	0.821	1.186
2004	1.189	0.784	1.025	1.160	0.931
2005	1.097	1.169	1.057	1.038	1.282
2006	0.896	0.805	0.959	0.935	0.722
Mean	1.013	0.973	0.994	1.019	**0.987**

Source: Calculated data using DEA method

TFPG and all its components fluctuated during the period of observation. The year 2001, 2003 and 2005 had the positive score with the highest growth of 28.2 percent observed in 2005. The mean of TFPG was 0.987 per annum, and this implied that, on average, the SMEs of Malaysian FPI had negative growth of 1.3 percent during the period of observation. The main contributor to the negative growth was the technological change with the value of 0.973 (-2.7 percent). Technological change associates with the ability of a firm to move up-ward the possibility production frontier. In other words, full efficiency firms can improve their productivity growth only by moving the frontier itself. In DEA concept, the possibility production function is a virtual function formed by the best practice which then compared against sample data of all firms. In practical, it relates to the technology management in the production process, for instance, using modern machinery, the skill of the labor, automation system, development of new products (innovation). Figure 5.9 illustrates the efficiency trend and total factor productivity change of the SMEs Malaysian food processing industry within the period of 2000-2006.

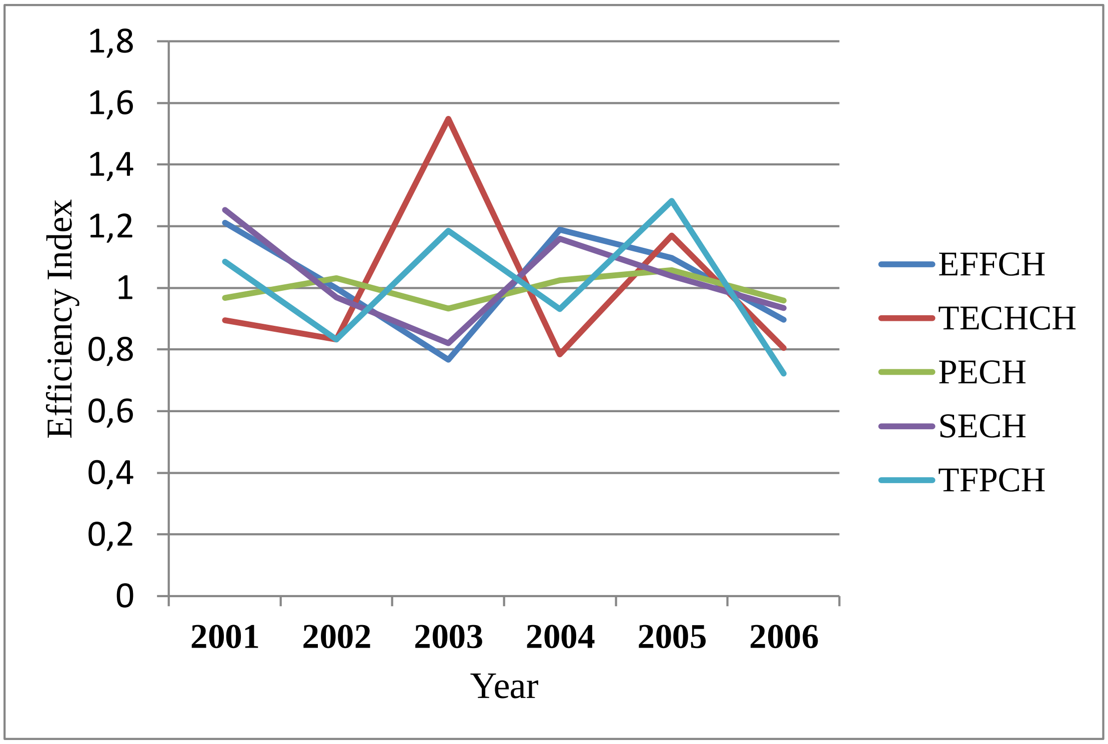


Figure 5.9 Trend of Total Factor Productivity Growth and the Components in the SMEs of Malaysian Food Processing Industry, 2001-2006

During the period of 2001-2006, the trend of productivity growth and its component showed declining figures. A positive growth observed in 2001 while a negative growth registered in 2002. From 2005 to 2006, however, productivity growth experiencing a sharp declined. In stark contrast to pure efficiency change (PECH), which had less variation over time, technological change, on the other hand, varied irregularly over time. Most of the value of PECH was either unity or closer to unity, which meant that there was no significant change of pure efficiency over the years. This phenomenon implied that the growth of the SMEs markedly influenced by the best practice (catching up) to the production frontier rather than shifting the frontier. In practice, the shifting of the production frontier can be implemented by employing new technology such as new machinery, modern IT equipment and automation.

Table 5.14 shows the summary, by sub industry, of Malmquist Index (MI) of the SMEs of the Malaysian FPI during 2000-2006. Sixteen out of 35 industries had positive growth (MI greater than unity) ranging from 3.6 percent to 34.4 percent. The top five sub-industries with positive TFPG were the sub-industries the processing of poultry and poultry products, manufacturing of crude palm oil, refined palm oil, noodle and ice. Technical efficiency change was the main contributor for high positive TFPG in the sub-industry, processing of poultry and poultry products. The contribution was as much as 32.1 percent, which indicated that, the industry operating closer to the production frontier. Two components of the technical efficiency change, pure efficiency change and scale efficiency change, recorded a value of 31.8 percent and 0.3 percent respectively. Lower positive TFPG recorded by sub-industries in the manufacturing of chocolate, soft drink, processing and preserving fish and fish products, and processing of mineral water.

Table 5.14 Summary of Malmquist Index in the SMEs of Malaysian Food Processing Industry, 2000-2006 by Sub Industry

No.	Sub Industry	EFCH	TECH	PECH	SECH	TFPCH
1	POULT	1.321	1.017	1.318	1.003	1.344
2	MEAT	1.154	0.793	1.000	1.154	0.915
3	FISH	0.973	1.072	0.979	0.994	1.044
4	PINAP	0.961	0.858	0.849	1.132	0.825
5	FRVGT	0.994	0.929	0.967	1.028	0.923
6	CCNT	1.153	1.005	1.000	1.153	1.160
7	PALMO	1.603	0.770	1.000	1.603	1.234
8	RFPLM	1.000	1.220	1.000	1.000	1.220
9	KERNO	1.000	0.796	1.000	1.000	0.796
10	OOTVG	0.911	1.016	1.000	0.911	0.926
11	ICECR	0.992	0.922	1.000	0.992	0.915
12	MILK	0.884	0.926	0.995	0.889	0.819
13	RICEM	1.016	1.129	1.000	1.016	1.148
14	FLOUR	1.000	0.847	1.000	1.000	0.847
15	OTFLO	0.970	0.924	0.866	1.119	0.895
16	GLUC	0.768	1.039	1.051	0.731	0.798
17	STARCH	0.831	0.897	1.000	0.831	0.745
18	FEEDS	1.000	1.158	1.000	1.000	1.158
19	BISCU	1.038	1.064	1.000	1.038	1.104
20	BREAD	0.959	1.022	0.961	0.998	0.981
21	SUGAR	1.023	0.972	1.000	1.023	0.994
22	COCO	1.146	0.866	1.000	1.146	0.992
23	CHOCO	0.984	1.052	1.000	0.984	1.036
24	NOODL	1.013	1.196	1.000	1.013	1.212
25	ICE	1.042	1.161	1.000	1.042	1.210
26	COFFE	0.911	1.020	1.000	0.911	0.930
27	TEA	0.870	0.750	1.000	0.870	0.653
28	SPICE	1.057	1.018	1.000	1.057	1.077
29	PNUT	0.938	1.138	1.000	0.938	1.067
30	SAUCE	1.042	0.857	0.886	1.175	0.892
31	SNACK	1.008	1.195	1.000	1.008	1.205
32	OTHER	1.000	0.845	1.000	1.000	0.845
33	ALCHO	1.000	0.957	1.000	1.000	0.957
34	SOFTD	1.000	1.055	1.000	1.000	1.055
35	MIWATR	1.213	0.877	1.000	1.213	1.064
	MEAN	1.013	0.973	0.994	1.019	**0.987**

Source: Calculated data using DEA method. The value is geometric mean.

The rest of 19 sub-industries had negative TFPG (MI less than unity) ranging from of -34.7 percent to -0.6 percent. Five of the lowest negative growths were sub-industries: manufacturing of tea, manufacturing of sago and tapioca starch, manufacturing of syrup, glucose and maltose, manufacturing of milk products and canning of pine apple as per presented in Figure 5.10. The main contributor to the declining growth was the technological change.

The SMEs in Malaysian FPI have limited R&D budget and innovation activities. From the total firms, only 55 percent of the SMEs undertook R&D activities. From this percentage, 59.4 percent of the SMEs concentrated on process improvement; 44 percent focused on new product development; 21.9 percent emphasized on innovations and technology (Second Industrial Master Plan of Malaysia, 1996-2005). In order to improve the firm's performance of the Malaysian SMEs, development of new products innovation and the improvement in the production process needs to get under way immediately. Countries, such as Belgium, implemented these two-pronged strategies, where innovation of small-food firms indicated by product innovation, process innovation, HACCP certificate, ISO system and organic logo (Avermaete, 2003).

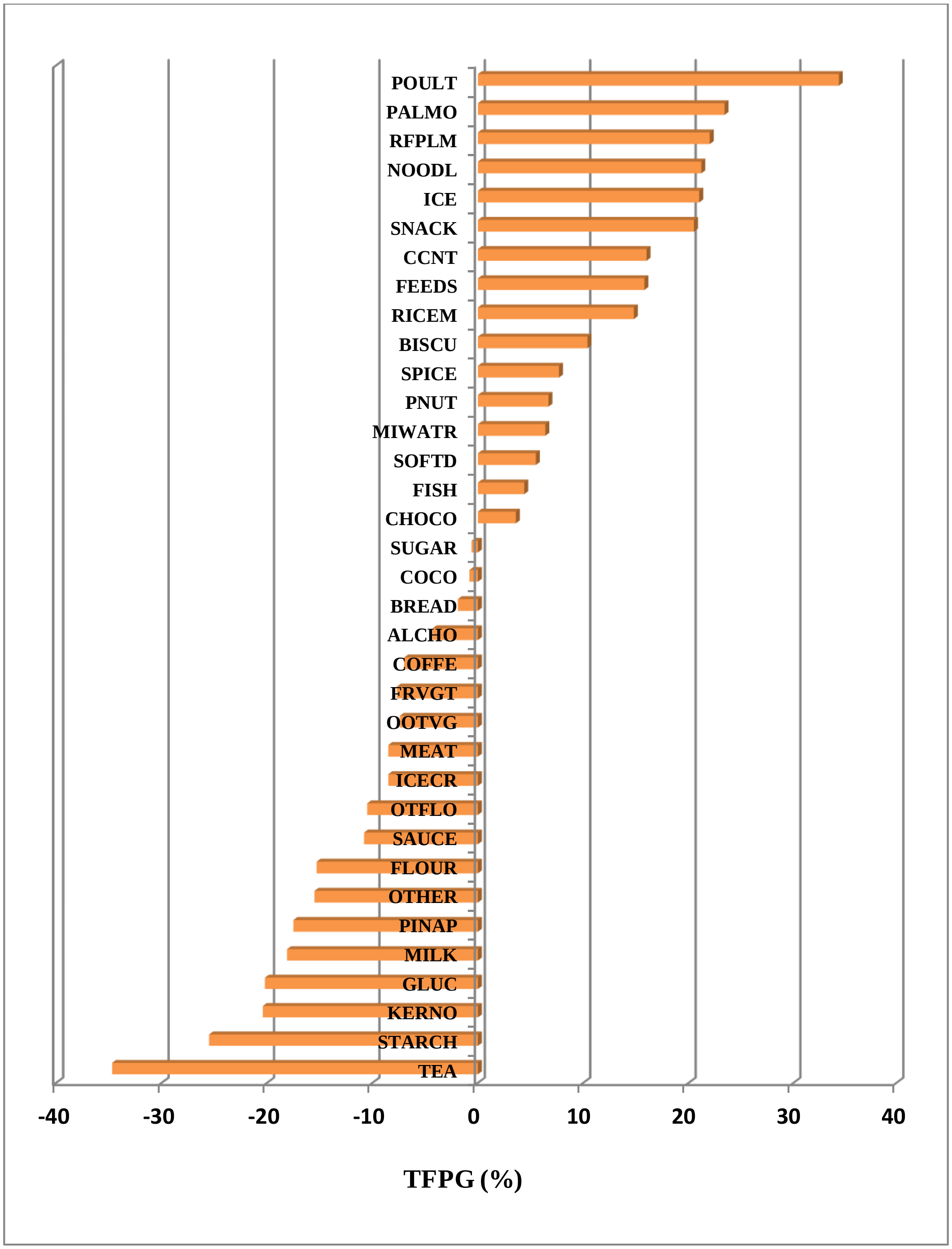


Figure 5.10 Total Factor Productivity Growth in the SMEs of Malaysian FPI, 2000-2006

5.5.2 Total Factor Productivity Growth in the LSEs

Table 5.15 presents the results of analysis of total factor productivity growth of LSEs in the Malaysian food processing industry. Compare to the SMEs, the TFP growth in the LSEs based on Mamlquist index was greater than unity, which meant that the industries experiencing a positive growth. Both EFCH and TECH gave positive contribution to the TFP growth. The TFP growth for the SMEs received a negative contribution from the TECH.

Table 5.15 Summary of Malmquist Index in the LSEs of Malaysian Food Processing Industry, 2001-2006 by Year

YEAR	EFCH	TECH	PECH	SECH	TFPCH
2001	0.876	0.863	0.981	0.893	0.756
2002	1.196	1.196	1.080	1.107	1.430
2003	1.001	1.173	0.938	1.067	1.174
2004	0.802	1.590	0.997	0.804	1.274
2005	1.314	0.590	1.030	1.275	0.775
2006	1.151	1.056	1.043	1.103	1.215
MEAN	**1.042**	**1.031**	**1.012**	**1.030**	**1.073**

Source: Calculated data using DEA method

During the period of 2000-2006, the LSEs of the Malaysian food processing industries had an average total factor productivity growth of 7.3 percent. The TFP growth was predominantly contributed by technical efficiency change and technological change with their respective values of 4.2 percent and 3.1 percent. DEA decomposed the technical efficiency change to pure efficiency change (PECH) and scale efficiency change (SECH) which contributed to EFCH by as much as 1.2 percent and 3 percent respectively.

Figure 5.11 illustrated the trend of total factor productivity growth and its components. During the period of observation, productivity growth seemed to increase at the average rate of 7.3 percent. The analysis identified 18 industries with positive growth in EFCH, 13 industries in TECH, 4 industries in PECH, 18 industries in SECH and 17 industries in TFPCH. There were 29 sub-industries experiencing zero growth in PECH during the period of observation. The measurement of PECH can be determined by weighing the production function in VRS against the production function in CRS. Therefore, it is worth noting that growth of PECH is the impact of management efficiency.

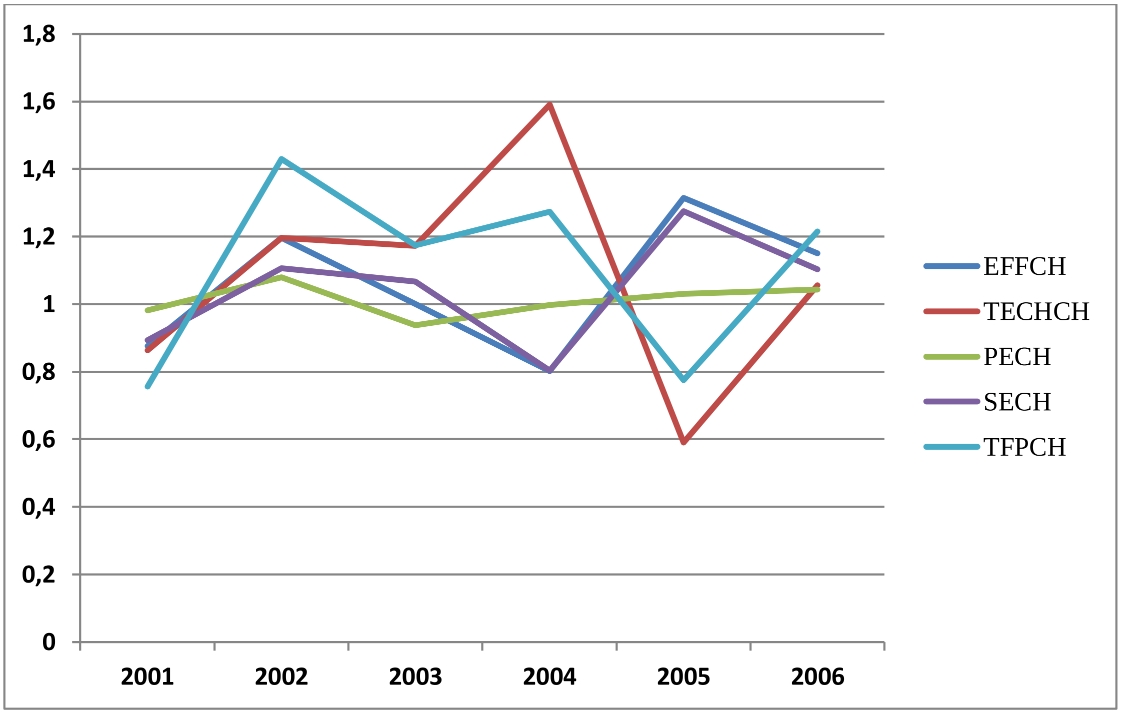


Figure 5.11 Trend of Total Factor Productivity Growth and the Components in the LSEs of Malaysian Food Processing Industry, 2001-2006

Table 5.16 presents the dispersion of total factor productivity growth and its decomposed component for every sub-industry. Technical efficiency change, which was the largest component that contributed to the positive TFPG, showed 23 sub-industries out of 27 had positive growth. The growth varied between 0.8 percent and 47.5 percent. Positive technological change observed in 14 sub-industries with the lowest being the manufacturing of biscuit and the largest being the manufacturing of alcohol (84.8 percent). Other 17 sub-industries had positive TFPG varied between 0.2 percent and 84 percent.

Table 5.16 Summary of Malmquist Index in the LSEs of Malaysian Food Processing Industry, 2001-2006 by Sub Industry

INDUSTRY	EFCH	TECH	PECH	SECH	TFPCH
POULT	0.986	0.705	1.000	0.986	0.695
MEAT	1.475	1.000	1.000	1.475	1.475
FISH	1.036	0.967	1.000	1.036	1.002
PINAP	0.679	1.401	1.000	0.679	0.951
FRVGT	1.024	1.162	1.000	1.024	1.189
PALMO	1.000	0.914	1.000	1.000	0.914
RFPLM	1.000	0.956	1.000	1.000	0.956
KERNO	1.047	1.335	1.042	1.005	1.397
OOTVG	1.238	1.273	1.158	1.069	1.576
ICECR	1.058	1.028	1.000	1.058	1.087
MILK	1.000	1.101	1.000	1.000	1.101
FLOUR	1.076	1.158	1.059	1.017	1.246
FEEDS	0.892	1.164	1.064	0.839	1.038
BISCU	1.059	1.012	0.990	1.070	1.072
BREAD	1.113	0.944	0.887	1.255	1.051
SUGAR	1.000	1.031	1.000	1.000	1.031
COCO	1.118	1.061	1.109	1.008	1.187
CHOCO	1.008	0.846	1.000	1.008	0.852
NOODL	1.215	0.985	1.000	1.215	1.197
COFFE	1.087	0.888	1.000	1.087	0.966
SPICE	1.029	0.919	1.000	1.029	0.946
SAUCE	1.033	0.999	1.000	1.033	1.032
SNACK	1.115	0.794	1.000	1.115	0.885
OTHER	1.103	0.797	1.000	1.103	0.879
ALCHO	1.000	1.848	1.000	1.000	1.848
SOFTD	1.103	0.846	1.000	1.103	0.933
MIWATR	0.838	1.288	1.000	0.838	1.079
MEAN	**1.042**	**1.031**	**1.01**	**1.03**	**1.073**

Source: Calculated data using DEA method

From the total of 27 observed sub-industries in the LSEs, there were 17 sub-industries with positive TFP growth varied from 0.2 percent to 84.8 percent. Another 10 sub-industries had negative growth, which varied from -30.5 percent to -3.4 percent. The most potential sub-industries in the LSEs in terms of higher total factor productivity growth were the manufacturing of alcohol, oil and fat from other vegetables, palm kernel oil, flour, and processing and preserving meat & other meat products. In contrast, sub-industries involved in the processing, preserving poultry and poultry products and manufacturing of chocolate had low total factor productivity growth. Considering that Malaysia is the third largest producer for poultry products and the fourth largest producer of chocolate in Asia Pacific, the finding is rather contradictory. Hence, it is plausible to say that these industries need attention from the policy maker, to understand the real problem of the TFPG.

Suppose that the TFPG growth can be divided into three levels of growth, i.e., low: 0.1-20 percent, medium: 10.1-20 percent and high: 20 percent up. Hence, the SMEs had six sub-industries grouped as high growth: processing and preserving poultry, manufacturing of crude palm oil, refined palm oil, ice, noodle and snack. Crude palm oil and refined palm oil industries are potential income earning from export. The processing and preserving poultry, ice, noodle and snack industries played a pivotal role in the domestic and export market supply chain. By using the same grouping manner, there were five sub-industries, which categorized as high TFP growth in the LSEs: manufacturing of alcohol, manufacturing of oil from other vegetables, processing and preserving of meat, manufacturing of kernel palm oil and manufacturing of flour as per presented in the Figure 5.12. During the period of observation, these five sub-industries experienced remarkable TFP growth. Sub-industry involved in the processing, preserving meat played a vital role as import substitution, since Malaysia is a net importer of meat products. Hence, it is crucial this industry gets all the necessary assistance for its development, so to reduce the dependency on imported meat.

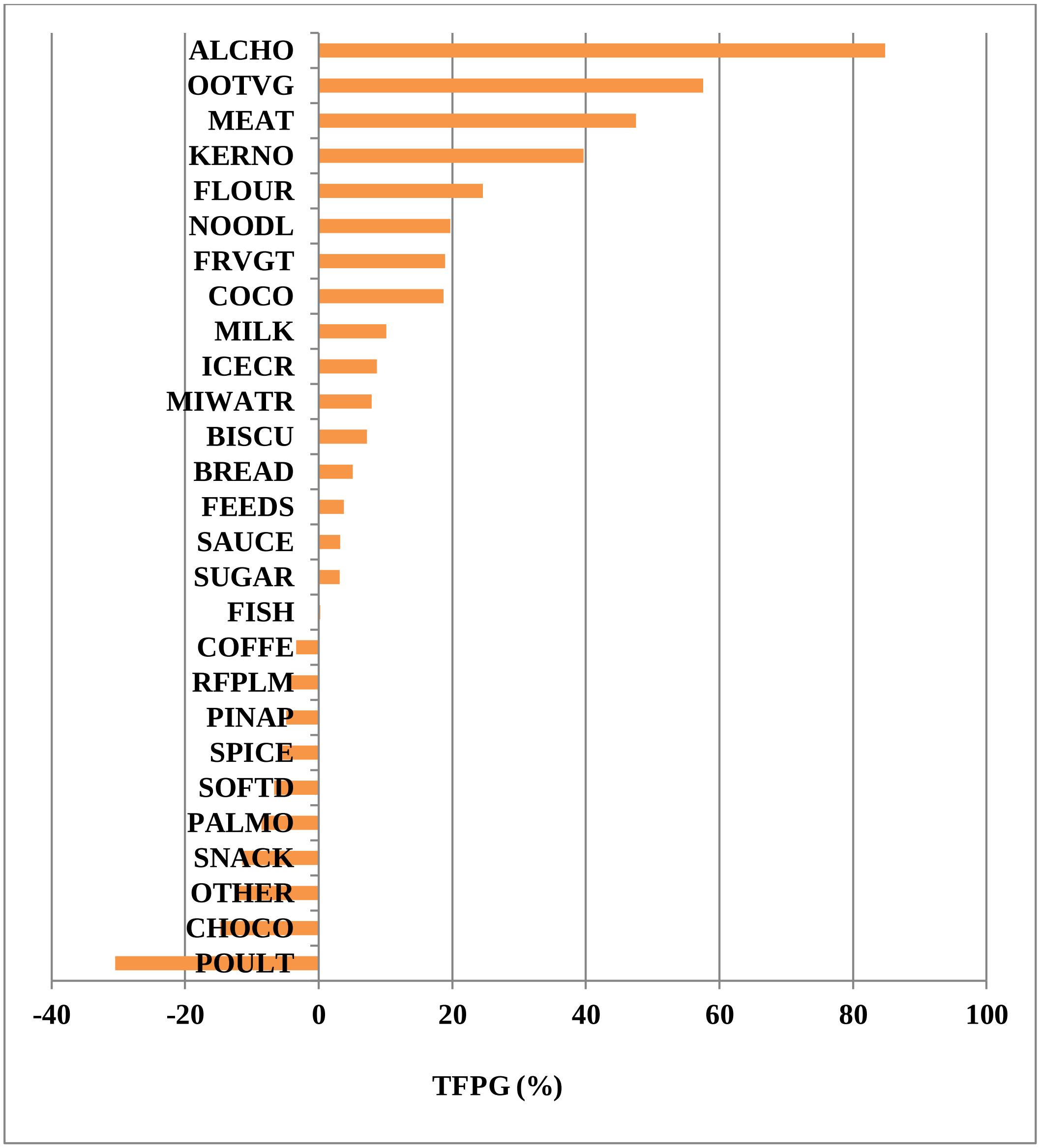


Figure 5.12 Total Factor Productivity Growth in the LSEs of Malaysian FPI, 2000- 2006

5.6 Determinants of Productivity Growth

This section discusses determinants of productivity growth in the Malaysian FPI. In order to investigate the determinants of productivity growth, ten independent variables selected and regressed to the total factor productivity growth and its components. The independent variables consist of six endogenous variables: firm R&D, staff training cost, information and technology expenditure, the university graduate workers, non-university graduated worker and foreign ownership as a dummy. Four exogenous variables are public infrastructure, foreign direct investment in the Malaysian FPI, trade openness index and world oil price (serves as energy price).

Identifying the determinants of productivity growth is vital for decision makers. In the present study, we investigate the determinants of productivity by using tobit regression method. Tobit regression is appropriate for a censored or truncated condition of dependent variable. Maddala (1991) explained that tobit model is a censored regression model where observations on the dependent variable y_i are censored (or unobserved) if y_i, $< c$. The explanatory variables, however, are observed for all i. While in the truncated regression model neither the dependent nor the explanatory variables are observed if $y_i < c$. Consider a latent variable y* defined as: $y^* = \beta' x_i + u_i$ where $u_i \sim IN(0, \sigma^2)$. The observed y_i is related to y* by the function:

$y = y^*$ if $y^* > c$, and $y = c$ otherwise, where c is a constant value, usually zero as lower limit. The parameters β and σ can be estimated by maximizing the likelihood function.

In the present study, TFP growth and its component, i.e., technical efficiency change, technological change, scale efficiency change and pure efficiency change, obtained from the DEA analysis and stood as dependent variables in the tobit regression. Since we want to identify the determinants of growth, then the dependent variable is left censored at low limit zero, and there is no limit on the right side. This censored is known as canonical censoring.

5.6.1 Data Panel Regression Analysis

The department of statistics Malaysia conducted a survey to the food industry sector every year. Therefore, the data obtained for both the SMEs and the LSEs were a cross section by industry and time series (during the period of observation). This data are normally known as a longitudinal or a panel data. In the panel data analysis, test conducted on stationary of data (unit root test) and determines the best-fit model using hausman test specification.

Unit Root Test

Basic assumptions of the classical linear regression: (1) the independent variable has no correlation with error (ε), (2) no significant co-linearity among the explanatory variables, (3) error terms are independent with expectation value equal to zero, (4) has constant variance (homoscedasticity) and (5) mean of variance expected to be constant or stationary data (Greene, 2003). If we used of the panel data, the co-linearity and error correlation problem was not a significant problem, and homoscedasticity could be controlled by selection model (fixed or random). Hence, the focus is to test the stationary of the data.

The stationary of data tested using panel unit root test. Levin and Lin (1993), Quah (1994) and Levin et al. (2003) developed unit root test for homogenous panels. Then other econometricians introduced unit root test for dynamic heterogeneous panels by likelihood estimation based on augmented Dickey Fuller (ADF) which widely used by econometrician. Table 5.17 shows the summary of analysis of panel unit root test of the variables. Null hypothesis in the test is that the variables have a unit root. Since t-statistic was significant (greater than 0.05), the null hypothesis rejected, and concluded that the variables had no root test, or in the other word data was stationer.

Tabel 5.17 Summary of ADF Unit Root Test of variables

Variable	SMEs			LSEs		
	Std error	t-stat	p-value	Std error	t-stat	p-value
TFPCH	0.155	-12.386	0	0.077	-16.421	0
EFCH	0.068	-15.552	0	0.073	-18.786	0
TECH	0.096	-8.322	0	0.077	-16.497	0
SECH	0.069	-15.639	0	0.220	-9.772	0
PECH	0.066	-16.608	0	0.221	-9.632	0
R&D	0.051	-4.108	0.001	0.064	-6.394	0
TRAIN	0.056	-5.087	0	0.066	-4.349	0
ITEXP	0.051	-4.323	0.001	0.054	-5.131	0
UNIV	0.069	-4.421	0	0.136	-4.764	0
NU	0.042	-4.822	0	0.056	-5.274	0
FOWE	0.061	-8.636	0	0.066	-6.81	0
FDI	0.312	-3.411	0.017	0.366	-2.968	0
GINF	0.312	-3.414	0.011	0.366	-2.971	0
WOILP	0.312	-3.411	0.012	0.366	-2.968	0
OPEN	0.312	-3.414	0.001	0.366	-2.971	0

Number of observation: 210 (SME) and 162 (LSE)
ADF: Augmented Dickey Fuller

Fixed Effect and Random Effects Model

Two models in the analysis of the panel data are fixed effects and random effects model. The term fixed effects and random effects relates to how coefficients in a model treat as fixed or random values. By using fixed effects, the omitted variables that are differing between individual but constant over time, can be controlled and the changes in the variables over time can be used to estimate the effects of the independent variables on dependent variables.

In contrast to the fixed effect, the rationale behind the random effect model is that the variation across individuals assumes to be random and uncorrelated with the independent variables included in the model. Baltagi and Kao (2000) noted with too many variables in fixed effects; it could loss degree of freedom. This problem can be avoided if the error term μi assume to be random. Random effect model is appropriate if working with random individuals from a large population. Specification test is necessary in choosing better model in the panel analysis between fixed and random effect model. The most common test is the Hausman test.

The Hausman test is based on the parts of the coefficient vectors and the asymptotic covariance matrices related to the slopes in the models and disregarding the constant term. The test seeks a more efficient model against a less efficient one and the more efficient model also gives a consistent result. It compares fixed effect model with random effect model by testing the null hypothesis that the coefficients estimated by the efficient random effect estimator are the same as the ones estimated by the consistent fixed effect estimator. Null hypothesis in the Hausman test tests that the first model are consistent and efficient, different in the coefficient and not systematic. The hypotheses are: Ho: that random effect is consistent and efficient, against H1: random effect would be inconsistent. If the result of Hausman's test shows a non-significant p-value (prob> $\chi 2$ is larger than 0.05) then it is safe to use the random effect. If p-value is significant (prob> $\chi 2$ is less than 0.05) then the fixed effect model is a better model (Baltagi and Kao 2000). Table 5.18 presents the result of analysis of total factor productivity growth and the component of SMEs and LSEs in the

Malaysian food processing industry. From the calculation, the best model to be used in the analysis is the random effect, except for TFPCH of the SMEs.

Table 5.18 Summary of the Hausman Test Specification for SMEs and LSEs in the Malaysian Food Processing Industry

	SMEs			LSEs		
Variable	χ^2	P> χ^2	**Model**	χ^2	P> χ^2	**Model**
TFPCH	230	0.000	Fixed	9.7	0.467	Random
EFCH	4.08	0.944	Random	2.76	0.987	Random
TECH	3.42	0.969	Random	11.42	0.326	Random
SECH	3.88	0.952	Random	5.11	0.884	Random
PECH	1.49	0.999	Random	4.72	0.909	Random

Number of observations: 210 (SMEs) and 162 (LSEs)

5.6.2 Determinants of TFP Growth in the SMEs

The productivity growth and its components regressed to endogenous and exogenous explanatory variables by using equation 4.24. Based on the Hausman specification test, the best regression model was the random effect model except for TFPG in the SMEs. The TFPG in the SMEs used fixed effect model because the result of Hausman specification test was not significant at 0.05 confidence level. Table 5.19

shows the summary of the determinants of productivity growth and the components of SMEs in the Malaysian food processing industry.

Table 5.19 Summary Statistics Determinants of Productivity Growth in the SMEs of Malaysian Food Processing Industry

	Determinants		**Coef.**	**Std. Error**	**z**	**P>|z|**
EFCH	GINF	***	0.797	0.154	5.17	0.000
	FDI	***	0.440	0.118	3.55	0.000
	FOWE	***	0.568	0.124	4.57	0.000
	OPEN	***	1.984	0.559	3.55	0.000
TECH	R&D	***	0.096	0.028	3.490	0.000
	GINF	*	5.643	2.923	1.930	0.054
	FDI	*	1.572	0.950	1.650	0.098
	OPEN	***	-5.426	1.246	-4.360	0.000
	FOWE	***	0.401	0.079	5.100	0.000
SECH	FDI	**	0.335	0.157	2.130	0.033
	FOWE	***	1.288	0.149	8.640	0.000
PECH	FOWE	**	0.638	0.313	2.04	0.042
			Coef.	**Std. Error**	**t**	**P>|t|**
TFPG	R&D	***	0.098	0.030	3.280	0.001
	TRAIN	**	0.073	0.032	2.240	0.026
	GINF	***	0.586	0.167	3.510	0.001
	OPEN	*	-1.864	0.977	-1.910	0.058

Source: Random effects regression, except for TFPCH (use fixed effect).
(***, **, * means significant at 1, 5 and 10 percent respectively)

Technical Efficiency Change

The most significant determinants of technical efficiency change (EFCH) in the SMEs were public infrastructure, foreign direct investment and foreign ownership. These three determinants were positively affecting the technical efficiency and significant at one percent confidence level, i.e. GINF, FOWE, FDI and OPEN. Public inferastructure had coefficient value of 0.797, which revealed that the increase of one percent in the public budget infrastructure expected to contribute by as much as 0.797 percent in the change of the SMEs's EFCH. The same interpretation could be drawn to foreign direct investment openness and foreign ownership, which had coefficient value of 0.440, 0.568 and 1.984 respectively. This finding is in line with the previous studies, for instance, Haughwout (2002), Kemmerling and Stephan (2002). Other positive determinants were R&D, training cost and non-university graduate of labor, but these factors had a lowly 10 percent significance level.

Technological Change

In the SMEs of the Malaysian FPI, technological change contributed as a deteriorating factor to the total TFPG. Such condition meant that overall the industries had no improvement in the production technology during the period of observation. Technological change depicts the shifting of the production frontier as an impact of employing new technology in production. However, new investment in technology, the production of the firm, needed strong financial capability and economic of scale. The positive determinants to the TECH shown in Table 5.19 above were R&D, public infrastructure, FDI and foreign ownership; each at significance level of one percent. The negative factors affecting to the TECH was openness. The finding needs further discussion because of the belief that openness of a trade traditionally gives positive effect to the productivity growth. In this case, food products especially processed food in Malaysia dominated by imported products. More liberalization trade regimes meant fewer barriers for an international trade regulation and easier for foreign products to enter the domestic market. The impact is not encouraging to the domestic producers, in particular for the SMEs due to higher competition in the market. Hence, it can be concluded from this finding that openness was a negative determinant.

Scale Efficiency Change

The significant determinants of the SECH are FDI and foreign ownership. Theoretically, the SECH measures the effect of input growth on output growth by calculating the ratio between CRS and VRS in the production frontier. Positive input growth gives the value of SECH greater than zero (increasing return to scale) and less than zero (decreasing return to scale). A larger value of SECH enables the firm to allocate more efficient inputs so that the production encompasses the economics of scale. Therefore, a larger producer tends to be more efficient than the smaller producer. FDI and foreign ownership are hand in hand affecting the productivity growth because a foreign investment controls by the investor through share of the ownership of the established business.

Scale efficiency relates to the size of company or industry (Kim and Shafi'i, 2009). The result of this study supported the argument that the higher SECH index (1.603) found in the largest size of the sub-industry (RM 3.13 billion) and the lowest SECH index (0.831) found in the smallest size of sub-industry (RM 31.5 million).

Pure Efficiency Change

As depicted in Figure 5.7, about 75 percent of the PECH score distributed at value of unity or close to unity. It means that there is no significant change in the PECH during the period of observation. It has an implication to the regression analysis where the PECH stand as the dependent variable. The result of the analysis identifies only foreign ownership as a significant determinant.

Total Factor Productivity Growth

The first stage of analysis shows the result that the SMEs in the Malaysian food processing industry have a negative TFP growth during the period of observation, as per discussed in the section 5.5.1 above. Industries with a negative TFP growth cannot survive in the long run. Therefore, the policy maker should pay more attention to encourage the performance of the SME. The determinants analysis using fixed effect model identified that the significant factors affecting the TFP growth were R&D, TRAIN and GINF (positive factors), and OPEN (negative factors). Mainly products of the SMEs go to local market. In open economic regime, barrier for entry of foreign product is very limited. Means more open economic, easier for foreign products to penetrate domestic market; especially Malaysia is a net importer of food product. Therefore openness is possible to be a deteriorating factor of TFPG in the SMEs of Malaysian FPI, because small industry unable to compete multinational company that produce goods in large scale, use machinery and strong R&D and innovation.

This finding was consistent with literatures that these factors supported productivity of the economic sector including the food industry. For example, Moreno et al. (2002) proved that public infrastructure had a positive effect on productivity and employment in Spanish manufacturing sector. Delorme et al. (1999) studied the U.S. economy found the same result. Delorme et al. (1999) suggested that public infrastructure indirectly affected the productivity by reducing technical inefficiency.

On the job training will increase the performance and productivity of a worker. However, a few empirical literatures highlight the relationship between cost of training and productivity growth. In the present study, we found the magnitude of the relation between training costs with the TFP growth was 0.073. It meant that one percent increase in the budget for training would increase 0.073 percent the productivity growth. Summary of determinants of TFP growth and components in the

SMEs of Malaysian food processing industry can be observed from Figure 5.13. We put the productivity growth and components in a circle shape and its determinants in a rectangular shape. The shapes in the yellow color meant that the factors had a deteriorating effect and shapes in green color meant the factors had an improvement effect.

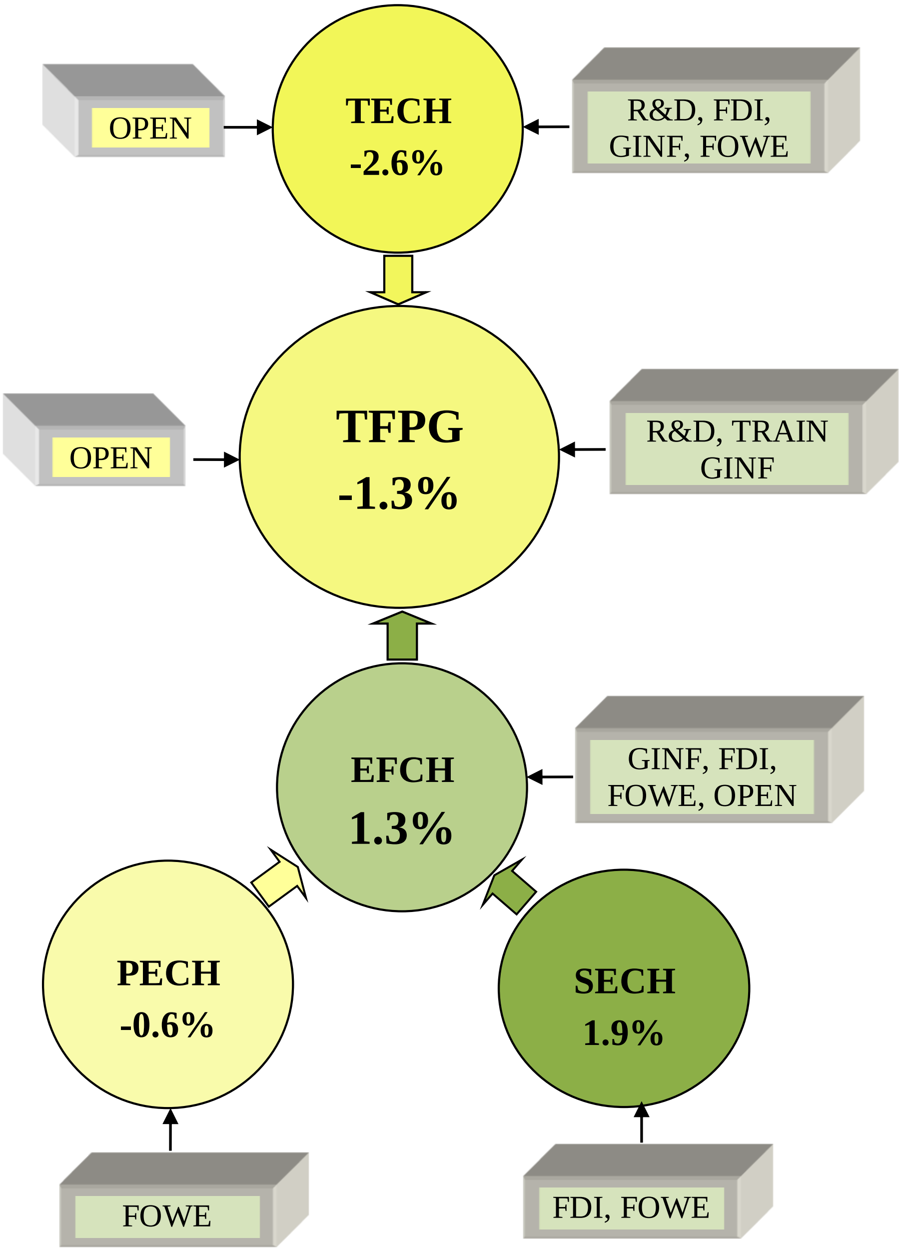


Figure 5.13 Determinants of TFPG and the Components in the SMEs

5.6.3 Determinants of TFP Growth in the LSEs

Based on the Hausman test specification, the best-fit model for the analysis of determinant of productivity growth in the LSEs of the Malaysian food processing industry was the random effect model. Table 5.20 presents the summary of determinants of TFP growth and components in the LSEs of Malaysian FPI.

Table 5.20 Summary Statistics Determinants of Productivity Growth in the LSEs of Malaysian Food Processing Industry

	Determinants	**Coef.**		**Std. Err.**	**z**	**P>|z|**
EFCH	R&D	0.089	***	0.025	3.560	0.000
	TRAIN	0.045	*	0.025	1.810	0.071
	ITEXP	0.034	*	0.020	1.670	0.094
	NU	-0.113	*	0.067	-1.690	0.091
	OPEN	3.307	**	1.411	2.340	0.019
	FOWE	0.844	***	0.125	6.760	0.000
TECH	TRAIN	0.235	***	0.016	4.780	0.000
	FOWE	0.291	***	0.080	3.630	0.000
SECH	R&D	0.060	**	0.030	1.980	0.048
	TRAIN	0.126	***	0.038	3.310	0.001
	NU	-0.308	***	0.085	-3.630	0.000
	GINF	0.970	*	0.570	1.700	0.089
	FDI	0.664	***	0.156	4.250	0.000
	OPEN	1.590	***	1.491	3.750	0.000
	FOWE	0.817	***	0.157	5.210	0.000
PECH	FOWE	0.720		0.386	1.870	0.062
TFPCH	ITEXP	0.058	**	0.027	2.140	0.033
	NU	-0.163	**	0.080	-2.040	0.041
	GINF	8.834	*	5.094	1.730	0.083
	WOILP	-3.853	*	2.123	-1.810	0.070
	FOWE	1.550	***	0.165	9.370	0.000

Source: Random effects model (***, **, * means significant at 1, 5 and 10 percent respectively)

Technical Efficiency Change

In contrast to the SMEs productivity growth, the LSEs experienced the positive productivity growth by as much as 7.3 percent annually during the period of observation. Technical efficiency and technological change were the main factors affecting the TFP growth at the rate of 4.3 percent and 3.0 percent respectively. The positive determinants for TE in the SMEs Malaysian FPI were R&D, training cost, IT expenditure, openness and foreign ownership. The R&D and foreign ownership were significant at one percent, training cost and IT expenditure significant at ten percent and openness significant at five percent level. From these determinants, the only factor could not be controlled by the management was openness. Three other factors were endogenous determinants, which could be controlled by a decision maker in the firm. The determinant's coefficients were relatively small except for the openness.

As the output of R&D activity and on the job training, firms gain a unique intellectual resource that positively contributes to the productivity growth. For examples patents, brand names, product reputation, trademarks, trade secrets, suppliers and consumer loyalty, advanced technological, and uncommon strategy about how to produce and sell a less expensive or superior product. All these outcomes can be converted into intellectual property or firm-specific assets. The negative determinant identified for the EFCH was the number of non-graduated worker. The phenomenon can be explained as most firms in the SMEs employ lower education level because of firm size, production technology and no research and development department.

Technological Change

The determinants of TECH were training cost and foreign ownership. All sub-industries in the LSEs allocated a budget for training cost were varied from RM 18 thousand (canning pineapple) and RM 2,397 thousand (manufacturing of condensed, flour and other milk products). On the other hand, not all the sub-industries in the SMEs allocated a budget for the training, and the amount budgeted varied from RM 3 thousand (manufacturing of coconut oil) up to RM 1,522 thousand (manufacturing of crude palm oil).

Foreign ownership causes technology spillover primarily in the manufacturing sector. It usually comes to a country through the direct investment frame by establish full foreign owned or joint venture firm. The foreign ownership changed the management style of the firm as well as production behavior, and encouraged the firm to obtain higher productivity. The local ownership can also exploit the superior knowledge, technology and management practice. Hence this factor was found as a positive determinant in most for productivity growth and the component both in the SMES and the LSEs. Benfratello and Sembenelli (2006), Dom and Jensen (1998) found that firm with foreign subsidiaries have larger TFP than domestically owned firm in the case of cross national productivity studies.

Scale Efficiency Change

The positive determinants of the SECH are R&D, training cost, public infrastructure, FDI, openness and foreign ownership. The significant negative factor for the SECH is non-university graduate worker. Theory behind the SECH said that the larger companies tend to have higher scale efficiency (Tsai and Wang, 2005). In our case, if the total assets of each sub industry proxy the size of sub industry, the SECH index was not varying according to the size of sub-industry. This condition presumably due to the ability of firms in the LSEs, especially in expanding the input growth has no big differences, so that it is not congruent with the sub industry size. Public infrastructure, FDI and openness are macro-economic factors in which the LSEs enjoy the benefits as the positive determinants. The coefficient of the determinants as per shown in the Table 5.20 were small, except for the openness (1.59). Hypothetically, this is an indicating that a one percent greater of trade openness index (sum of total import and total export divided by GDP) expected to give effect as much as 1.59 percent to the change of productivity growth in the LSEs of Malaysian food processing industry.

Pure Efficiency Change

A consistent PECH index was found in the SMES and in the LSEs. There are 20 sub industries out of 27 experiences with zero growths of PECH, only five sub industries have positive growth, and two industries have negative growth. The regression result has shown that foreign ownership stands as a significant factor affecting the PECH with coefficient 0.72 and the confidence level is 10 percent.

Total Factor Productivity Growth

From the first stage on the analysis, the LSEs have positive total TFP growth of average 7.3 percent during 2000-2006. The main contributor was the technical efficiency change of 4.3 percent and technological change of 3.0 percent. This founding is contrast to the TFP growth in the SMEs, which has a negative growth. Look again to the input and output growth as per discussed in section 5.2 above, the input growth in the LSEs was greater than the growth in the SMEs. This is an indicating that the sub industry in the LSEs as general can allocate their expanding of input optimally.

As shown in the Table 18, the significant determinants of the TFPG were ITEXP, GINF and FOWE (positive determinants); then NU and WOILP (negative determinants). Foreign ownership is a significant contributor to the TFPG, and this founding was consistent with the existing literature. For example, Isik (2007) reported foreign ownership in the Turkey's industry sector robust the productivity growth, which comes from increasing the technical efficiency changes. Since last four decades Malaysia government has attracted foreign investment actively to gain several benefit including job generation, technology spillover and income. Foreign direct investment has a positive relationship to foreign ownership because the foreign investors have a share as the owner of the firm. Public infrastructure in the model enhances TFPG; the estimates indicate that, on average these components influence TFPG at 8.8 percent. This result higher than the effect found in more developed countries, for example, study by Cahill (2004) on Canada's food industry, that obtained public infrastructure raised 0.8 percent points to the TFPG.

Food processing is one the fastest growing industry in the manufacturing sector which attracts foreign investor to do business in this country. Therefore, foreign ownership is an important factor to strengthen the performance of domestic firms. Foreign ownership may be through a joint venture or a subsidiary of a multinational company. World oil price is also a significant determinant in a negative direction. By the magnitude coefficient as much as 0.0853, it can be interpreted during 2000-2006 an increasing one percent of world oil price have worsened the TFPG of 0.0853 percent. Nevertheless, this equation is still raw to be used as forecasting about the effect of change world oil price to the change in TFPG of LSEs because the complexity of dynamic changes in food industry performance. World oil price which proxy as energy price in the model, just one of the exogenous variables and give impact to input and output price as well. Hence, in this study a more accurate relationship between the dependent variable and the explanatory variables may be explored by focusing to a sub industry or using a firm level data based on the initial clue of this finding. Summary of the determinants of TFPG in the LSE of Malaysian FPI can be observed from Figure 5.12. The positive contributor to the TFPG is the technical efficiency change (3.0 percent) and technological changes (4.3 percent) indicated by green filling. The education level of a worker below university graduate was a negative determinant for EFCH, SECH and TFPG. Interestingly, foreign ownership was a positive factor for all dependent variables.

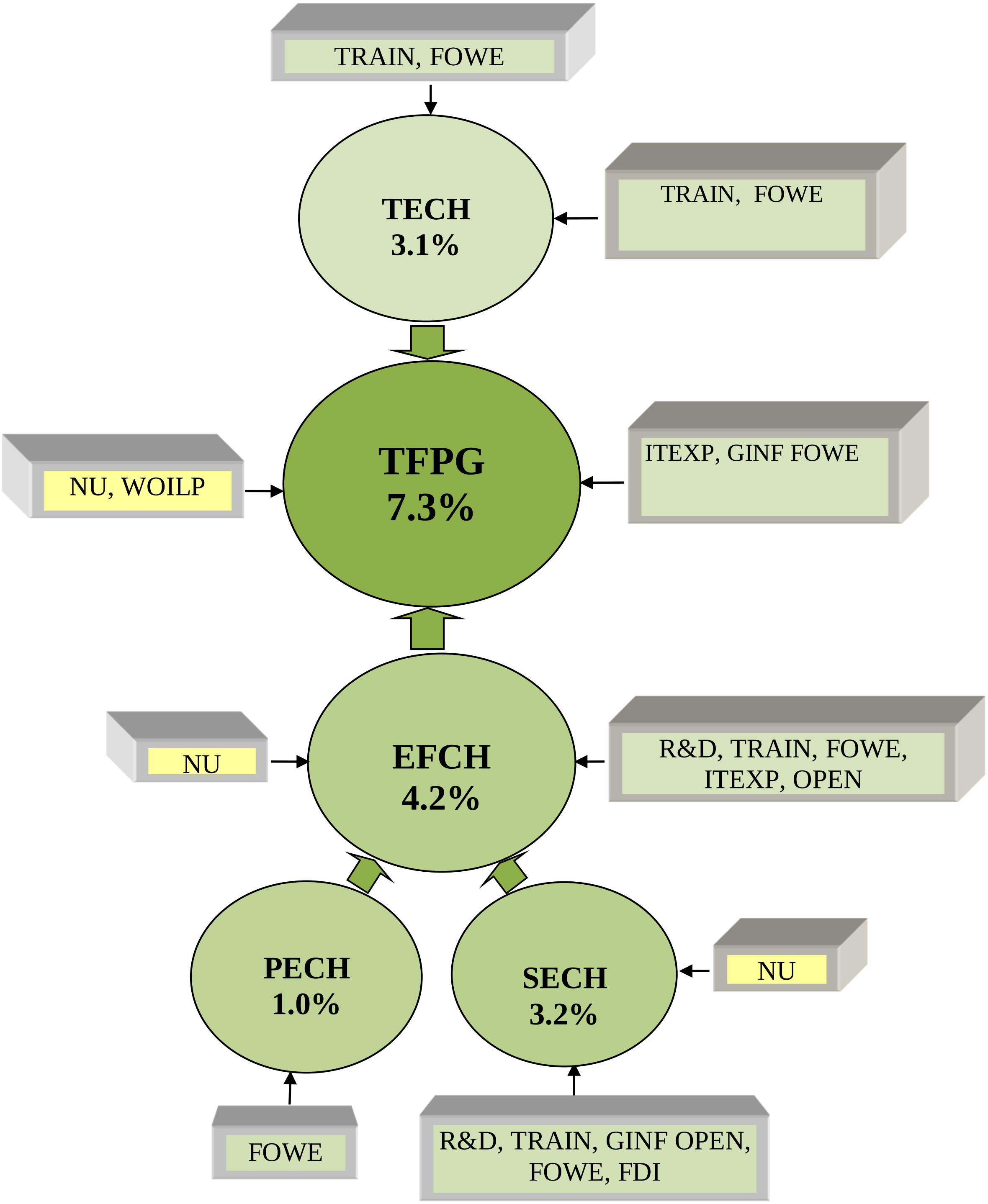


Figure 5.14 Determinants of TFPG and the Components in the LSEs

CONCLUSION

The foremost objective of this study is to examine the efficiency and productivity growth in the Malaysian FPI. A non-parametric approach, DEA, employed as the analysis tool during the study. The results showed that the average TE in the SMEs during the period of observation were 0.756 (75.6 percent) and 0.945 (94.5 percent) based on CRS and VRS respectively. The average TE in the LSEs were 0.683 (68.3 percent) and 0.952 (95.2 percent) based on CRS and VRS respectively. The readings suggested that the SMEs could potentially expand their output to as much as 24.4 percent and the LSEs to as much as 31.7 percent.

The results revealed that SMEs were more technically efficient than that of the LSEs. Growth of the TE fluctuated over the years. For the SMEs, CRS technical efficiency had positive average growth of 0.602 percent and VRS technical efficiency had negative growth of 0.570 percent per year. For the LSEs, the TE growths were positive for both CRS and VRS at the rate of 4.49 percent and 0.86 percent respectively. Our finding is consistent to the recent literature about the Malaysian food manufacturing industry as reported by Muhamad and Said (2010) who suggest that 18 sub-industries were operating under the efficient frontier.

The determinants were identified by using tobit regression analysis. The positive determinants for TFP growth in the SMEs were public infrastructure, R&D, foreign ownership and foreign direct investment. The fact of the matter is, however, the openness had negative influences on technological change and TFP growth. Determinants that positively affecting TFPG and its components in the LSEs were public infrastructure, R&D, training cost, foreign ownership, IT expenditure, openness, and foreign direct investment. Negative determinants were non graduate workers and energy price. The results are consistent with the previous study as discussed in sections 5.6.2 and 5.6.3.

The understanding about the performance of sub-industry in the Malaysian FPI is useful in recognizing high-potential sub-industry with high TFP growth. FPI plays a vital role in the Malaysian manufacturing sector as an import substitution for food products as well as income earner. Having information about high-potential sub-industry with high TFP growth, gave the policy maker indicators that would help them formulate new strategies. The two industries in the SME, manufacturing of chocolate and processing of poultry, can be considered the largest in Asia Pacific region. Unfortunately, the results of the analysis showed that these two sub-industries were inefficient as they only produced about 30 percent of output under frontier. In the LSEs, these two sub-industries, manufacturing of chocolate and processing of poultry, had negative TFP growth of each as much as 30.5 percent and 14.8 percent. However, in the SMEs, they showed positive growth of 34.4 percent and 3.6 percent respectively.

After experiencing an impressive run of TFP growth in recent years, notably, there are six industries in the SMEs that have an exciting future ahead of them. Those industries are manufacturer of crude palm oil, refined palm oil, ice, noodle, snack, and companies that process and preserve poultry-related products. Crude palm oil and refined palm oil industries have a bright future as a potential income earner through export activities. Industries involved in the processing of poultry, ice, noodle and snack play a vital role in fulfilling the demand for both domestic and overseas markets. In the meantime, potential sub-industries in the LSEs include those involved in the manufacturing of alcohol, vegetables oil, kernel palm oil, flour, and the processing and preservation of meat related products. Those five sub-industries in the LSEs experienced remarkable TFP growth in recent times. Sub-industries that handle processing and preservation of meat related products could play a role as an import substitution since Malaysia is a net importer of meat products. By formulating the right strategies and policies, this country dependency on imported meat products could be reduced with the development of these industries.

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Appendix 1 Descriptive Statistics for the First Stage Analysis of SMEs

	N	Minimum	Maximum	Mean	STD Deviasi
VA	245	1293.49	2746537.24	129159.63	357412.93
LABOR	245	86.00	28830.97	2542.87	4845.26
WAGE	245	1252.00	436205.31	35682.24	67220.14
CAPITAL	245	1233.00	3714972.15	204187.84	519030.26
MATERIAL	245	2751.00	19955552.60	732385.78	2456835.43
MHW	245	111498.00	49438884.76	3789092.14	7864130.17
OVER TIME	245	0.00	11377114.13	441669.37	1724409.38
WATER	245	8.00	13885.34	1081.68	1893.02
ELECTRCITY	245	45.94	58003.83	7799.52	10543.24
FUEL	245	103.00	157271.97	9086.81	20245.39
Valid N (listwise)	245				

Appendix 2 Descriptive Statistics for the Second Stage Analysis of SMEs

	N	Minimum	Maximum	Mean	STD Deviasi
R&D	210	0	34352,06	607.36	325.129.0
TRAIN	210	0	3219.00	160.97	373
ITEXP	210	0	6340.00	295.14	994
UNIV	210	0	1080.93	110.11	170
NU	210	83.00	28124.00	2444.77	4694
GINF	210	6299000.00	8933000.00	78588066.00	978621
FDI	210	391384.00	895364.00	533261.67	169696
OPEN	210	1.72	2.25	1.92	.1989
WOILP	210	23.12	61.68	37.22	14.164
FOWE	210	0.00	1.00	0.47	0.5003
Valid (listwise)	210				

Appendix 3 Descriptive Statistics for the First Stage Analysis of LSEs

	N	Minimum	Maximum	Mean	STD Deviasi
VA	189	4439.00	1083044.00	169890.2	222203.69
LABOR	189	199.00	8687.00	1805.60	1511.89
WAGE	189	3504.00	262397.00	38658.45	34845.02
CAPITAL	189	5256.00	1297737.53	239775.11	222712.14
MATERIAL	189	11730.00	15157738.09	905124.30	2092237.54
MHW	189	24870.00	15934736.00	2816818.86	2681868.15
OVER TIME	189	0.00	4964638.00	465037.68	658295.21
WATER	189	17.76	65869.07	1710.61	5288.91
ELECTRCITY	189	257.00	73943	10608.37	13096.22
FUEL	189	0.00	124060.03	11755.91	20058.90
Valid N (listwise)	189				

Appendix 4 Descriptive Statistics for the Second Stage Analysis of LSEs

	N	Minimum	Maximum	Mean	STD Deviasi
R&D	162	0	34352,06	607.36	325.129.027
TRAIN	162	0	3219.00	160.97	373
ITEXP	162	0	6340.00	295.14	994
UNIV	162	0	1080.93	110.11	170
NU	162	83.00	28124.00	2444.77	4694
GINF	162	6299000.00	8933000.00	78588066.00	978621
FDI	162	391384.00	895364.00	533261.67	169696
OPEN	162	1.72	2.25	1.92	.1989
WOILP	162	23.12	61.68	37.22	14.164
FOWE	162	0.00	1.00	0.47	0.5003
Valid (listwise)	162				