Total Factor Productivity and Its Contribution to Malaysian Palm Oil- Based Industry Output Growth

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ABSTRACT

In Malaysia, the contribution of TFP towards its economic growth is still small even though it is increasing over time and this reflects a low contribution at the firm level as well. This paper attempts to examine the contribution of TFP growth to palm oil-based industry output growth. As Malaysia stands the second largest oil palm producer in the world, the palm oil-based industry is one of the important subsectors of the manufacturing sector. The analysis in this paper is based on panel data of 13 years from 2000-2012 and eleven palm oil-based subindustries. The data are provided by the Depatment of Statistics, Malaysia. The TFP growth is obtained from the data envelopment analysis (DEA) of Malmquist index procedure and this variable is used as one of the independent variables in the growth model. Other variables include expenditure on training, information and communication technology (ICT) and research and development (R&D). The model is run using pooled ordinary least squares (POLS), fixed effect (FE) and random effect (RE) procedures. The results demonstrate that TFP growth positively and significantly contribute to industry's output growth. The contribution of TFP growth to output growth is higher in the non-food-based industry compared to food-based industry.

Keywords: Total factor productivity, data envelopment analysis, output growth, palm oil-based industry.

1. INTRODUCTION

The Organisation for Economic Cooperation and Development (OECD) defines productivity as the ratio of total output to total input. Productivity measures the efficiency level of production input utilization such as capital and labour in the economy in producing the required output. In the literature, there are two important approaches in measuring productivity i.e. labour productivity and total factor productivity (TFP). Labour productivity measures the output per unit of labour, while TFP measures total productivity of overall factors of production that caused by the increase in input quality such as improvement in technology, human resource management and human capital. Good quality inputs will directly generate more output without the increase in their quantity, especially when the inputs are effectively and efficiently utilized. TFP is an

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efficiency measurement of input utilization in producing maximum output or minimizing input utilization in producing the same quantity of output.

A higher contribution of TFP to economic growth is necessarily important in improving people's living standard (Malaysia Productivity Corporation or MPC, 2009). Thus, the nation should focus on improving the contribution of TFP growth to gross domestic product (GDP) growth. Besides that, in order to achieve the vision of being a developed and high income nation by 2020, productivity has to be given a priority. An improvement in productivity will bring in good implication or benefit, may it be to the nation, organizations or individuals through profits or higher income, better reputation and reduction in resource wastage. In general, the contribution of TFP to Malaysian economic growth is still low, whereas the major contributor is the capital input (MPC, 2016). For the manufacturing sector, TFP experienced a high growth rate of 1.5 percent during the 10th Malaysia Plan compared to 1.3 percent during the 9th Malaysia Plan. The increase in TFP growth during the 10th Malaysia Plan is a result of good investments in the manufacturing sector towards producing more complex and varieties of products. High investment was put in the machineries and sophisticated automation to increase the industries' competitiveness at the global market. Moreover, improvement in the skilled labour and greater cooperation with research institutions also contribute to the high TFP growth.

A high TFP growth is highly needed at the industrial level, especially by the backbone industries to a country's economic growth. In view that Malaysia is one of the biggest producers of palm oil, thus, palm oil- based industry is particularly important. Today the overall palm oil industry is one of the major contributors to Malaysian economic growth. This industry will remain relevant in view that it is expected to contribute RM178 billion to Malaysian exports by the year 2020, about threefold in value compared to the exports of RM63.6 billion in 2014. The palm oil industry encompasses the production chain, i.e. from the upstream plantation to downstream processing. However, land productivity is not increasing due to lack of land for cultivation. As such, upstream industries that are palm oil-based industry need to be strengthen. Currently, upstream industries makes up 21.4 percent of Malaysian palm oil production compared to 78.6 percent of downstream export products, both of raw and processed forms.

At the end of 2014, there were 443 factories, 44 crashers, 57 refineries and 17 oleochemical factories in operation. The operating capacity of factories in 2014 for fresh fruit bunch (FFB) reached 106.7 million tonnes, crushed palm kernel at 6.9 million tonnes, refineries at 27.1 tonnes and oleochemical at 2.6 million tonnes. The Performance Management and Delivery Unit (PEMANDU) in the Economic Transformation Program Annual Report (2012) stated that Malaysia is currently active in promoting the nation's palm oil after this commodity being identified and convinced as one of the national key economic areas (NKEA) that needs to be transformed, i.e. its entire value chain and plantation activities up to the finished product. The National Key Economic Palm Oil or more known as Palm NKEA is a long term government's strategy to drive Malaysian economy towards a high income nation by 2020. It is expected to be Malaysia's main commodity with an expected gross national income (GNI) to soar from RM53 billion in 2009 to RM178 billion by 2020, with a focus on eight entry point projects.

This article attempts to examine the level of TFP growth and analyse its contribution to the output growth of palm oil- based industries in Malaysia. The writing of this article is segregated into five sections. The second section reviews past studies, followed by methodology and model specifcation in the third section. The fourth section deals with study results; and finally the conclusion in the fifth section.

2. LITERATURE REVIEW

2.1 Total Factor Productivity (TFP)

Past studies that are related to TFP had been conducted by utilizing various data, such as data from firms and industries as well as national level data, which encompassed cross-section and time series data. These studies also utilized various methodologies to analyze their data such as the Data Envelopment Analysis (DEA) and Stochastic Frontier (SFA). The scope of the studies were also different, from studying only the level of TFP growth, extending them to identify the determinants of TFP growth as well as examining the contribution of TFP growth towards output growth.

Study by Idris (2007), using data of 1971 to 2004 in Malaysian showed that the level of TFP growth was low and it was due to the negative contribution from technical efficiency. By using panel data, the study revealed that the economy was able to shift its own frontier, based on innovations, and concluded that the presence of foreign companies in Malaysia was the major contributor to the higher TFP growth. Another study on the TFP for Malaysia for the period of 1997 to 2006 showed that on average, the growth of TFP was 1.6 percent and contributed 29.0 percent to GDP growth (Zaffrulla, 2007). Some studies revealed that TFP growth of the manufacturing sector even though positive, but it was substantially low, less than 0.5 percent (Mahadevan, 2002; Tham, 1997, Idris and Rahmah, 2007). In other studies, the result showed that the foreign companies had better TFP growth than the local companies (Yumiko and Fredrik, 2001). This is as a result of the latest technological adoption and higher composition of skilled labour in the foreign companies. In another study by Noorasiah and Norfadila (2013) using Malaysian manufacturing data of 2000-2005 revealed that TFP growth was still low compared with other developing countries. During that period, the study showed that the leather manufacturing subindustry achieved the highest TFP growth followed by the transport equipment industry.

The studies in this area are often extended to examine components that contribute to TFP growth, i.e. either changes in efficiency or changes in technology. For example, Mohamad Ikhsan-Modjo (2006) found that in Indonesian manufacturing sector for 1988-2000 period, technical change contributed positively towards TFP growth but the contribution of technical efficiency change was negative. Selin Ozyurt (2009) examined TFP growth in Chinese industry for 1952-2005 period. He found that technical change contribute largely toward TFP growth compared to technical efficiency change.

Joshi and Singh (2010) conducted a study based on firm's panel data of the clothing industry collected from the Indian Economic Monitoring Centre for years 2002-2007. The variable for output is gross sales with four inputs, i.e. fixed asset, net income, raw material and fuel. The Malmquist Productivity Index based on the DEA approach was used to measure TFP growth. The study showed that during that period, the Indian clothing industry had a medium TFP annual growth rate of 1.7 percent. The TFP growth which was categorised into several components was mainly due to technical efficiency change and not through technological changes. Heshmati and Kumbhakar (2010) studied

TFP growth by utilising industry panel data of China region. Results showed that on the average, technical changes contributed between 13.7 percent and 22.3 percent to TFP growth; and it was the main contributor to TFP growth. However, a study by Manello et al. (2016) in Italy showed that TFP growth was propelled by an increase in efficiency change.

Further, Sharma and Sehgal (2011) used various subsectors of the manufacturing industry at Haryana (India) for the period of 1981-1982 and 2007-2008. In their analysis, the researchers made a comparison between “inter-temporal’ and “inter-industry”. TFP was calculated using Malmquist productivity index method through the Data Envelopment Analysis (DEA) method. Study result found that technical efficiency was the main driver to TFP growth for the manufacturing sector during the pre-reform period. However, the contribution of technological changes had been successful increased during the reformed period, i.e. 2007-2008. The liberalization policy has a positive impact on the technological development of the manufacturing sector at Haryana, India. Saha (2012) analysed the determining factor of TFP growth, i.e. the ratios of trade-GDP, export-GDP and import-GDP. Study result indicated that all the three variables were positively and significantly related to TFP growth.

Norma (2012) examined the efficiency and TFP growth of general or non-life takaful and insurance industry in Malaysia during the period 2007 to 2009. It was found that, on average, the TFP of the non-life takaful and insurance industry in Malaysia was mainly due efficiency change and the main sources of the efficiency change are both scale efficiency and pure efficiency. Overall, on average, all firms had not increased their TFP for the period of 2007-2009. But TFP change, on average, shows some growth of 5.6 percent for the period 2008-2009. Castiglionesi and Ornaghi (2013) studied the components of total factor productivity growth in Spanish manufacturing firms using 1990-2006 data. They found that the major component of TFP growth was technical efficiency change. Technical change contributed a small portion of TFP growth.

Researchers often focus on the outside factors rather then TFP growth components when examining the determinants of TFP growth, such as economic openness, labour skills and R&D expenditure. For example, Heshmati and Kumbhakar (2010) further extended their study to examine the determinants of TFP growth. They found that TFP growth was determined mainly by human capital and economic changes. The economic changes are associated with the purchase of infrastructures, technological adoption and technological transfer as well as the ability of that region to learn new knowledge.

2.2 TFP and Output Growth

Analysis on TFP growth towards output has been done at various stages, i.e. firms, industries and nation. This kind of analyses are important in examining the extent of TFP growth contribute to output growth. The goal of a nation is to increase the contribution of TFP growth to reduce production cost and be more competitive at the global market.

Results of analyses at national level can be obtained from several studies. For example Ikemoto (1986) provided estimates of the TFP growth rate for 1970-1980 period for several Asian economies using the Tornqvist index. He differentiates the contributions of between the domestic and imported capital. His result indicated that productivity growth was positive in all economies considered. The contributions of TFP growth to overall growth in Taipei, China and Republic of Korea are very high. On the other hand, those of Hong Kong, China; Malaysia; Philippines; Singapore; and Thailand are much lower. Ikemoto indicates that in the cases of Hong Kong, China; Malaysia; and Singapore these economies already have a high level of technology, and thus it is more difficult to realize productivity gains. Dyah (2004**)** conducted a study in Indonesia and found that industrial strategy in Indonesia resulted in a higher TFP growth. The development of manufacturing sector in Indonesia can be seen from three periods, i.e. import substitution, export promotion and financial crisis. However, output growth was contributed more by capital, labour and raw material compared to TFP growth. The small contribution of TFP growth towards Indonesian economic growth reflects the less efficient utilization of input.

Baier et al. (2006) studied the importance of physical capital, human capital and TFP growth towards economic growth of 23 countries in the world. They found that the contribution of TFP toward output per labour was about 14 per cent. In another study, Selin Ozyurt (2009) examined TFP growth in Chinese industry for 1952-2005 period and showed that the input growth are seen to give a stable contribution towards the output growth. Hafiz Khalil et al. (2010) studied the contribution of TFP growth to economic development for four Asian countries (Hong Kong, Korea, Malaysia and Thailand) using fixed effect model and regression model (POLS) for period 1970-2004. Results showed that TFP significantly contributed to production growth. In Malaysia, Elsadig (2012) studied TFP growth in Malaysian food manufacturing industry for two period of time 1971-2000 and 1987-2000. He found that the TFP growth level was still low and 13 of 27 food subindustries witnessed negative contribution from TFP growth towards output growth. This findings are due to low technological adoption in the food industry. Meanwhile, Rahmah et al. (2014) studied TFP growth in Malaysia for the 1971-2007 period. Study found that TFP growth contributed towards economic growth, but its contribution was still low compared to capital and labour. In fact, capital is the most important contributor to Malaysian economic growth.

3. METHODOLOGY AND MODEL SPECIFICATION

Analysis of this article utilizes data gathered from the Manufacturing Industrial Survey, provided by the Department of Statistics, Malaysia. The data cover 13 years period from 2000 to 2012; and 11 selected subsectors of palm oil-based manufacturing industry. But there will be 132 observations for panel data at the growth level of ouput and TFP. In this study, all variables measured in value such as output, assets, ICT expenses, training expenses, research and development expenses are measured in real terms using 2010 as the base year.

In order to obtain TFP growth, the study uses Malmquist productivity index method through the Data Envelopment Analysis (DEA) procedure. The TFP growth is then used as one of the independent variables in the regression analysis to look at its impact on the industrial output growth. Due to short time series data, the dynamic panel data analysis cannot be employed, instead we use static panel data. Three estimation models are employed to include Ordinary Least Square (POLS), fixed effect (FE) and random effect (RE) models and some tests are performed to choose the best model.

3.1 Data Envelopment Analysis (DEA) and TFP Growth

Malmquist productivity index combines the technical efficiency index and technical changes index. One of the advantages of the Malmquist index is that the researchers can utilise quantitative data that are not price dependent. This is particularly useful as researchers often faced the problem of where pricing does not reflect the market value. Also, Malmquist index is not dependent upon the assumptions that firms are operating at minimum cost and maximum income. These advantages are not found in other productivity indices such as Tornqvist and Fisher indices. By utilizing Malmquist panel data index, the source of productivity changes can be categorized into two components, i.e. technical efficiency change index and technological change index.

Malmquist index is an approach towards analyzing TFP change (TFPCH), technological change (TECHCH), technical efficiency change (EFFCH), and scale efficiency change (SE) (Fare et al., 1994). This concept originated from the ideas of Malmquist (1953) (Kaoru Tone, 2004). TECHCH refers to the increase in TFP when industry utilised new discoveries, while EFFCH refers to increase in TFP when industry utilised existing technology and input more efficiently.

In this study, Malmquist productivity index is based on output oriented; whereby the focus is to achieve highest output using the existing inputs. In other words, Malmquist productivity index is a ratio of aggregate output to aggregate inputs. Thus, equation (1) can be written as follows:

$$m_0(y_s, x_s, y_t, x_t) = [m_0^s(y_s, x_s, y_t, x_t) \, . \, m_0^t(y_s, x_s, y_t, x_t)]^{0.5} \qquad (1)$$

In this context, Fare et al. (1994) specified the Malmquist productivity change index as:

$$m_0(y_s, x_s, y_t, x_t) = \left[\frac{d_0^s\ (y_t, x_t)}{d_0^s\ (y_s, x_s)} \text{ x } \frac{d_0^t\ (y_t, x_t)}{d_0^t(y_s, x_s)}\right]^{0.5} \quad , \text{s= t+1} \qquad (2)$$

Where, $m_0(.)$ represents technical efficiency index, x is the utilised input and y is output. Besides that, $d_0^s\ (x_t, y_t)$ represents the distance from t period compared to technology at s period. m_0 that exceeds one indicates positive TFP growth for both periods, and otherwise if m_0 is less than one; this shows that TFP growth becomes negative compared to the previous period. Besides that, the Malmquist productivity index can be written as equation (3).

$$m_0(y_s, x_s, y_t, x_t) = \underset{\text{(EFFCH)}}{\frac{d_0^t\ (y_t, x_t)}{d_0^t\ (y_s, x_s)}} \text{ x } \underset{\text{(TECHCH)}}{\left[\frac{d_0^s\ (y_t, x_t)}{d_0^s\ (y_s, x_s)} \text{ x } \frac{d_0^t\ (y_t, x_t)}{d_0^t(y_s, x_s)}\right]^{0.5}} \qquad (3)$$

Where change in Malmquist TFP index is divided into two components, i.e. efficiency change (EFFCH) and technological change (TECHCH). The ratio outside of the parentheses is to measure efficiency change between period s and period t. Meanwhile, the geometric mean inside the parentheses is to measure technological change between period s and t.

Theoretically, the Malmquist index for TFP change based on the assumption of Cabanda (2001) is the multiplication product of technical efficiency change (EFFCH) and technological change (TECHCH). The equation is as follows:

$$\text{TFPCH} = \text{EFFCH} \times \text{TECHCH} \tag{4}$$

If Mo>1, then TFPC growth is positive from period s to period t. Meanwhile, if the result is otherwise, i.e. Mo<1, then TFPC growth is deteriorating.

3.2 Estimation Model

There are two estimation models involved in the study. Model 1 is formed without dummy variable to differentiate the effect of TFP growth on the output growth between food-based and non-food-based industry. In model 2, the interaction term between food-based industry and TFP growth is added to the model. The models are written as follows;

$$gy_{it} = \beta_o + \beta_1 TFP_{it} + \beta_2 ln(K/L)_{it} + \beta_3 (PROF/TL)_{it} + \beta_4 (TECH/TL)_{it} + \beta_5 \ln ICT_{it} + \beta_6 \ln TRN_{it} + \beta_7 \ln RND_{it} + \mu_{it} \tag{5}$$

$$gy_{it} = \beta_o + \beta_1 TFP_{it} + \beta_2 ln(K/L)_{it} + \beta_3 (PROF/L)_{it} + \beta_4 (TECH/TL)_{it} + \beta_5 \ln ICT_{it} + \beta_6 \ln TRN_{it} + \beta_7 \ln RND_{it} + \beta_8 (DM * TFP)_{it} + \mu_{it} \tag{6}$$

Where, gy_{it} is the output growth rate, TFP_{it} is TFP growth, $^{K}/_{L}$ is the capital labor ratio, i.e. fixed asset divided by number of labour, PROF/TL is the ratio of professional workers (includes professionl, managerial and executive) to total labour, TECH/TL is the ratio of technical workers (includes technical and associate professional) to total labour; ICT is the expenses on information technology and communication, TRN is the expenses on worker training, RND is the expenses on research and development which is a proxy of technological level, i is industry, t is time, ln is natural logarithm and μ_{it} is error term. DM is dummy variable, DM=1 if food-based industry and DM=0 if non-food industry.

Three types of static panel data analyses are adopted, i.e. constant coefficient estimator, fixed effect estimator and random effect estimator. Constant coefficient estimator model is related to the estimation using Pooled Ordinary Least Squares (POLS). This model assumes intercept for the industry is constant. The fixed effect model assumes the intercept to be different for the *cross-section* unit. Meanwhile, the random effect model assumes that the intercept as a random variable for all the pooled data. Hypothesis testing is done as to identify the best estimator to estimate the model. In determining the best model, i.e. constant coefficient estimator model or fixed effect estimator model, hypothesis testing is done by one way fixed effect cross section test. The hypothesis testing is as follows:

H0 = constant coefficient estimator
H1 = fixed effect estimator

The F-test's result can be obtained by utilizing the "*Coefficient Diagnostic*" test. If F-stat finds $p < 0.05$, then the null hypothesis is rejected; thus, the fixed effect is better than the fixed coefficient estimator (POLS). It will be otherwise if $p > 0.05$ where null hypothesis fails to be rejected. This shows that constant coefficient estimation model is better than fixed effect estimation model.

Further, in order to determine the better model, i.e. between fixed effect model and random model, Hausman test is conducted. The study hypothesis is as follows:

H0 = random effect estimator
H1 = fixed effect estimator

If the estimation result is significant, i.e. $p<0.05$, then H_0 is rejected. Thus, fixed effect estimator is better, and vice versa.

4. RESULTS

4.1 TFP Growth Performance

Table 1 depicts TFP growth according to sub-industries of palm oil-based. The range of TFP growth is between 0.6 and 2.0. It is found that most industries are within the low range, i.e. between 0.6-1.0, encompassing 67 sub-industries during the period 2000-2012. A total of 64 sub industries are in the medium range, i.e. between 1.1-1.5; and only one industry is in the high range of 1.6-2.0, i.e. condensed, powdered and evaporated milk. Sub industries that often fall within the medium range include the manufacturing of kernel oil, manufacturing of liquefied or compressed inorganic industrial or medical gases, and manufacturing of pharmaceutical, medicinal chemical and botanical products. Meanwhile, the usual sub-industries that fall within the low range include manufacturing of crude palm oil; condensed, powdered and evaporated milk; other food products; soap and detergent; cleaning and polishing preparation; perfume and toilet preparations.

Table 1: TFP Growth by Palm Oil-Based Subindustry

Subsector	Range			Total
	0.6-1.0	1.1-1.5	1.6-2.0	
Manufacturing of crude palm oil	7	5	0	12
Manufacturing of refined palm oil	6	6	0	12
Manufacturing of palm kernel oil	5	7	0	12
Manufacturing of ice cream and other edible ice such as sorbet	6	6	0	12
Manufacturing of condensed, powdered and evaporated milk	7	4	1	12
Manufacturing of other food product	7	5	0	12
Manufacturing of liquefied or compressed inorganic industrial or medical gases	5	7	0	12
Manufacturing of basic chemicals	6	6	0	12

Manufacturing of soap and detergent; cleaning and polishing preparation; perfume and toilet preparations.	7	5	0	12
Manufacturing of other chemical products	6	6	0	12
Manufacturing of pharmaceutical, medicinal chemical and botanical products.	5	7	0	12
Total	67	64	1	132

Source: computed based on the Industrial Manufacturing Survey data for palm oil-based industry

TFP growth by year for 11 sub industries are depicted in Figures 1 and 2. Generally, all sub industries experienced fluctuation in their TFP growth during the period of 2001-2012. However, the fluctuation is more obvious for industry 4, manufacturing of ice cream and other edible ice such as sorbet. For palm oil food- based industry, industries 1, 2 and 3 (manufacturing of crude palm oil, manufacturing of refined palm oil, and manufacturing of kernel oil) have been experiencing high TFP growth during the study period. Industry 6 (manufacturing of other food products) has the lowest TFP growth followed by industry 5 (manufacturing of condensed, powdered and evaporated milk) nonetheless, there is no drastic fluctuation recorded.

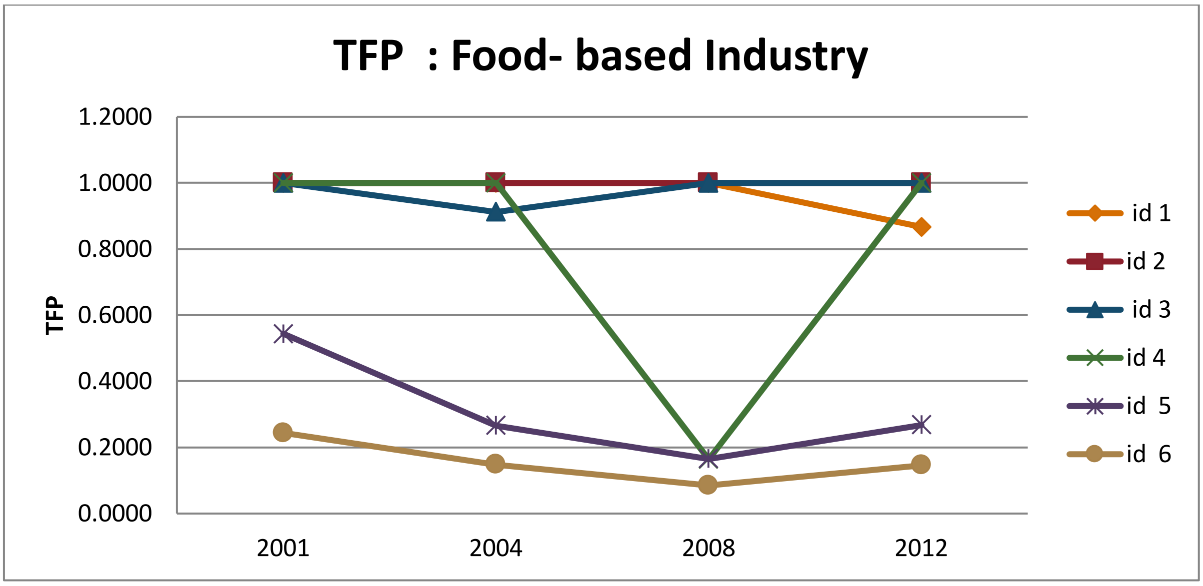

Figure 1: TFP growth for Palm Oil Food-based Industry

For the non-food based industry, industry 9 (manufacturing of soap and detergent; cleaning and polishing preparation; perfume and toilet preparations) experienced the lowest TFP growth; followed by industry 10 (manufacturing of other chemical product) and 11 (manufacturing of pharmaceutical, medicinal chemical and botanical products). However, the growth is highly unstable for industry 11 (manufacturing of pharmaceuticals, medicinal chemicals & botanical products) which is highly dependent upon global competition and consumer taste towards imported products.

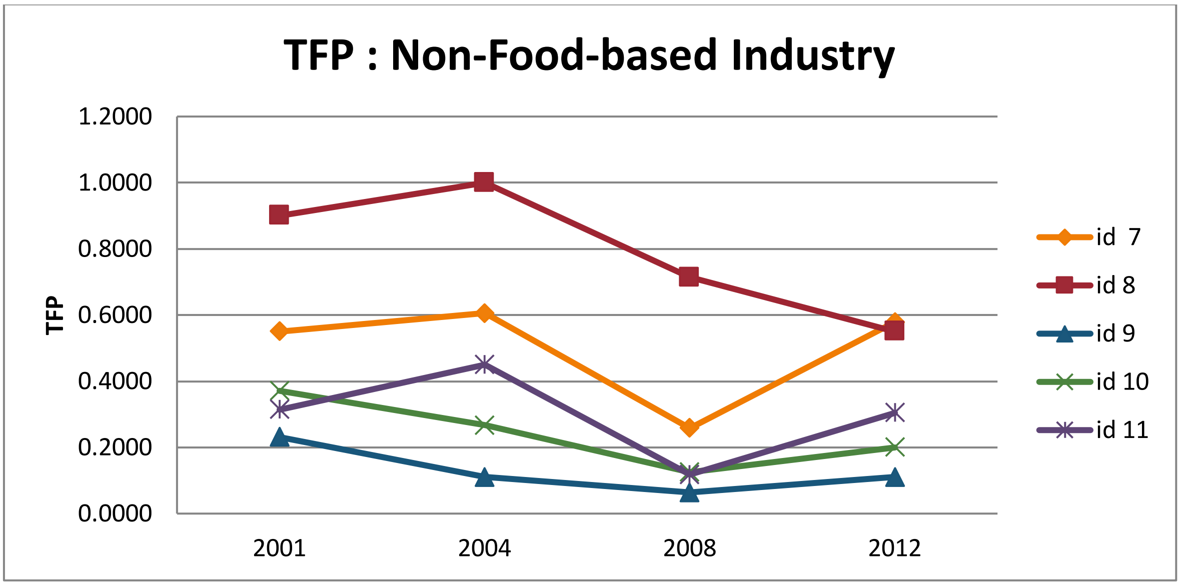

Figure 2: TFP Growth for Non –Food- based Palm Oil Industry

Notes: Industry 1- manufacturing of oil and fat from vegetable and animal (Id1=MSIC10401: manufacturing of crude palm oil Id2=MSIC10402: manufacturing of refined palm oil, Id3= MSIC 10403: manufacturing of kernel oil); Industry 2- manufacturing of dairy products (Id4= MSIC 10501: manufacturing of ice cream and other edible ice such as sorbet, Id5=MSIC10502, 10509: manufacturing of condensed, powdered and evaporated milk); Industry 3- manufacturing of other food products (Id6=MSIC10799: manufacturing of other food products); Industry 4- manufacturing of basic chemical, fertilizer and nitrogen compound, plastics and synthetic rubber in primary form (Id7=MSIC20111: manufacturing of industrial or medicinal gases, Id8=MSIC20112, 20113, 20119: manufacturing of basic organic chemical); Industry 5- manufacturing of Pharmaceuticals, Medicinal Chemicals & Botanical Products (Id9: Manufacturing of soap and detergent; cleaning and polishing preparation; perfume and toilet preparations, Id10=MSIC20231: manufacturing of other chemical products); Industry 6- manufacturing of other chemical product (Id11=MSIC21007: manufacturing of pharmaceuticals, medicinal chemicals & botanical products).

4.2 Output Growth Performance

Figures 3 and 4 show the output growth trend of the palm oil-based industry. The rate is different for food and non-food-based sub industries. For the period of 2001-2012, there were fluctuations in output growth in all the sub industries. For food-based industry, high output growth was recorded for the period of 2001-2004 in sub industry 1; but it declined after that period, until a negative growth was recorded in the year 2012. Negative growths were also recorded for sub industries 4 and 6 in the same year. Competition in food production, locally and abroad, has dampened the output growth of the food-based industry.

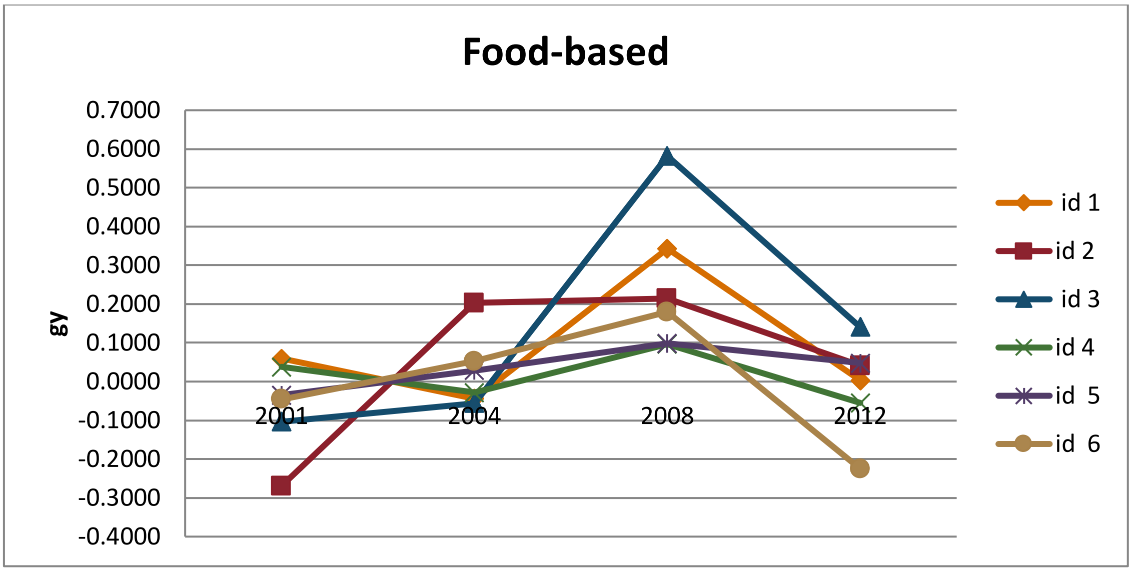

Figure 3 : Output Growth in Palm Oil Food-based Industry

For the non-food-based industry, the highest output growth is recorded in subindustry 7, while the lowest growth is in subindustry 9. In 2004, the growths rate are peak for all industies but declined in 2008 onward due too world economic crises. Even most subindustries recorded negative growths in 2012 except subindustry 8, which maintained a positive growth even though its growth was negative in 2001.

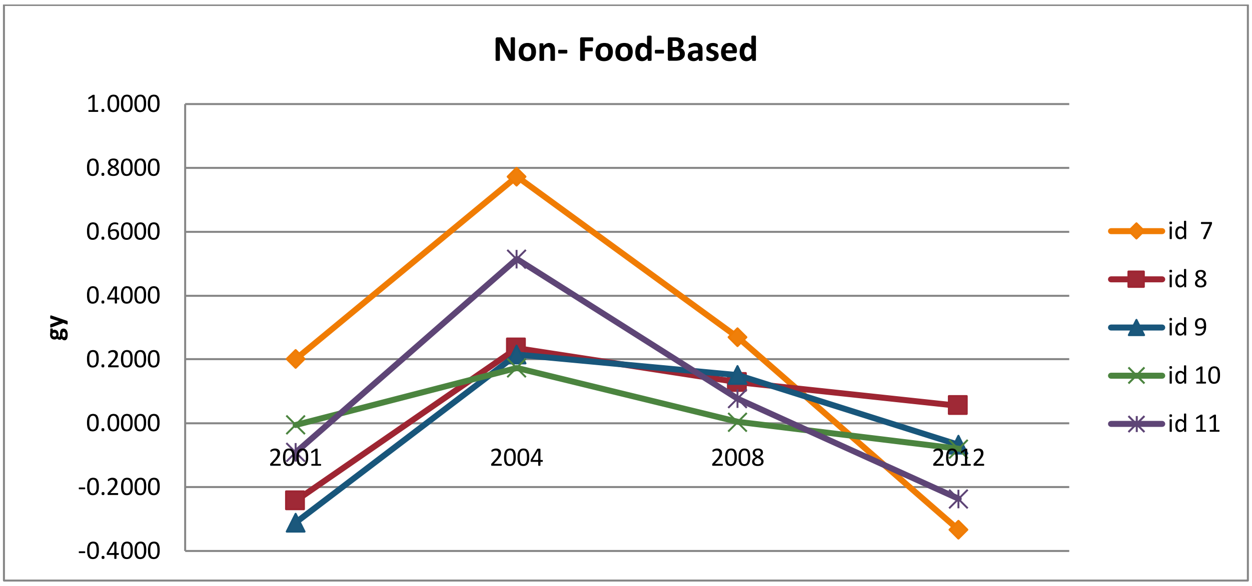

Figure 4: Output Growth in Palm Oil Non-Food-based Industry

4.2 Descriptive Statistics

The purpose of the descriptive statistics is to find out the statistical features of every variable used in the model. Among statistical features to determine statistical behaviour of the variables are mean, median, standard deviation, skewness, kurtosis and Jarque-Bera. Mean refers to the average value of each variable for the whole samples, while standard deviation shows variation (dispersion) of data from the mean value. Skewness is a series of asymmetrical distribution measure around the mean. Symmetrical distribution skewness is like normal distribution, and has a value of zero. If there is a negative skew, the distribution skewed to the left; while, a positive skew means that the distribution skewed to the right. Kurtosis is a statistical measure to describe distribution and skewness relative to a normal distribution. Data sets with high kurtosis tend to have outliers, while data sets with low kurtosis have few outliers. Data are normally distributed (normal distribution) if the kurtosis value is equal to 3. If the kurtosis value is greater or less than 3, the data sets leaned to the sides from normal distribution. Meanwhile, Jarque Bera tests the *goodness-of-fit*; i.e. whether sample data have skewness and kurtosis matched to normal distribution. If significant, then the data are normally distributed. Descriptive statistics in Table 2 show that some kurtosis values are smaller or lower than 3 but the values of Jarque-Bera are all significant. Thus, data sets used are normally distributed and estimated results are valid.

On average, the output growth of the palm oil- based industry is 5.6 percent. The natural logarithm of capital-labour ratio is 5.3431 (RM209.16). Professional and technical workers comprise 12.03 percent and 13.4 percent respectively. On average, the TFP growth is positive at 5.75 percent. The natural logarithm of expenses on ICT, workers training and R&D are 9.0003 (RM8, 105.52), 7.5495(RM1, 899.79) and 7.7842 (RM2, 402.34) respectively. About 58.45 percent of the industry are in food-based industry.

Table 2: Descriptive Statistics of Variables

Variable	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability	Observations
gy	0.0557	0.2504	-0.0893	4.4409	11.5942	0.0030	132
lnK/L	5.3431	1.0631	0.9216	3.262519	19.0659	0.0001	132
PROF/TL	0.1203	0.0519	0.7572	3.7937	16.0783	0.0003	132
TECH/TL	0.1344	0.0463	0.4460	2.9703	4.3819	0.1118	132
TFP	1.0575	0.2083	0.4834	3.634874	7.3588	0.0253	132
lnICT	9.0003	1.1123	-1.0276	4.0602	29.4110	0.0000	132
lnTRN	7.5495	1.4734	-0.5305	3.9995	11.6861	0.0029	132
lnRND	7.7842	1.8787	-1.3669	5.4095	73.0392	0.0000	132
DUMMY* TFP	0.5845	0.5593	0.0755	1.3637	14.8505	0.0006	132

4.3 Output Growth Model Estimation Results

Table 3 shows the estimation results of two output growth models for palm oil-based industries. Model 1 is estimated without the dummy variable of food-based industry. Meanwhile, the interaction term of dummy variable for food-based industry with TFP growth is added in Model 2 to see the different effect of TFP growth between food and non-food industry towards output growth. Panel data analysis is performed using three approaches to test the hypothesis for the best model selection. First, to choose between

Pooled Ordinary Least Squares (POLS) and fixed effect models, the F-test was performed. The result shows *p* value lower than 0.05, which rejects the null hypothesis. This shows that the fixed effect model is better than the POLS model. Second, to choose between the fixed effect and random effect models, Hausman test was performed. The test shows that we reject the null hypothesis at 5 percent significance level. This means fixed effect model is more suitable than random effect model. Thus, we choose fixed effect model as the best model. The value of R^2 are 0.3259 and 0.3890 for fixed effect model 1 and model 2 respectively. It shows between 32.59 percent and 38.9 percent of the variation in the dependent variables are explained by the independent variables.

Based on the fixed effect model 1 in Table 3, the result shows that TFP growth is very significant in determining the output growth of the palm oil-based industry. An increase of 1 percentage point in TFP growth will increase the output growth 0.2336 percentage point. Other significant variables are capital-labour ratio and expenditure on ICT, which are positively affect the output growth. A one percent increase in capital-labour ratio will increase output growth by 0.1443 percentage point, while a one percent increase in expenditure of ICT will increase output growth by 0.1168 percentage point. The effect of TFP on the output growth is higher in the food-based industry compare to the non-food-based industry. For the fixed effect results in model 2, all variables are significant, showing the expected sign, except the ratio of professional workers and expenditure on workers' training, which indicate the negative sign. This implies, when the ratio of professional workers and training expenditure increase, the output growth decreases.

Table 3: Output Growth Model Estimation Results

Variable	Model 1			Model 2		
	POLS	Fixed Effect	Random Effect	POLS	Fixed Effect	Random Effect
Constant	-0.7597 (0.2424)***	-1.7927 (0.5028)***	-0.7597 (0.2030)***	-0.8218 (0.2574)***	-1.8629 (0.0403)***	-0.8218 (0.2474)***
ln K/L	0.0283 (0.0425)	0.1443 (0.0835)*	0.0283 (0.0327)	0.0280 (0.0426)	0.1051 (0.0055)***	0.0280 (0.040)
TFP	0.3285 (0.1027)***	0.2336 (0.0358)**	0.3285 (0.1041)***	0.3015 (0.1094)***	0.1747 (0.0047)***	0.3015 (0.1051)**
$PROF/TL$	-0.6158 (0.6333)	-1.6722 (1.3621)	-0.6158 (0.5563)	-0.3155 (0.7562)	-1.4746 (0.0035)***	-0.3155 (0.7269)
$TECH/TL$	0.3931 (0.6952)	-0.1677 (1.1393)	0.3931 (0.7820)	0.3443 (0.6997)	0.1538 (0.0287)***	0.3443 (0.6725)
ln ICT	0.0580 (0.0470)	0.1168 (0.0528)**	0.0580 (0.0302)*	0.0602 (0.0472)	0.1241 (0.003)**	0.0602 (0.0045)
ln TRN	-0.0294 (0.0364)	-0.0101 (0.0488)	-0.0294 (0.0379)	-0.0313 (0.0365)	-0.0098 (0.0037)***	-0.0313 (0.0351)
ln RND	0.0048 (0.0153)	0.0100 (0.0190)	0.0048 (0.0123)	0.0091 (0.0164)	0.01577 (0.0011)***	0.0091 (0.0157)
DM* TFP	-	-	-	0.0403 (0.0552)	0.2785 (0.0118)***	-0.8218 (0.4491)
R^2	0.1287	0.3259	0.128755	0.1325	0.3890	0.1325
Durbin-Watson	2.446480	2.367258	2.446480	2.442115	2.177836	2.442115

F-test)	1.769540 0.0689* Reject Ho			48.724066 0.000 *** Reject Ho		
Hausman test Probability (χ2-test)	19.335051 0.0072 *** Reject Ho			19.733379 0.0114 ** Reject Ho		
Observation	132	132	132	132	132	132

Notes: Figures in bracket are standard deviation. ***, **,*, significant at 1%, 5% dan 10 % significance level respectively.

This suggests the increase in highly-skilled workers ratio reduces output growth; which might be due to the workers' incompatibility with the level of technology used. This is proven as technical workers ratio gives a positive impact on the industry output growth; due to their compatibility with the level of technology used. Most industries are food-based, and the technology used is at the moderate level. The negative effect of training expenses on the output growth could be due to insufficient workers, when they are on training. However, the increases in R&D and ICT expenditures increase the industry output growth. Further, the results show that the effect of TFP growth on the output growth is higher in the food-based industry compared to the non-food based industry.

5. CONCLUSION

The paper examines the level of TFP growth for palm oil-based industry using 132 industry panel data. Three models were regressed to choose the best fitted model and the fixed effect model was selected for the analysis. Based on the results of model 1 and model 2, it is shown that TFP growth is positive and significantly affect the output growth of the industry. Other positive and significant variables are expenses in ICT, R&D, capital labour ratio and ratio of technical workers. But the professional workers ratio and training expenses are negatively associated with output growth of palm oil-based industry under study.

The results from this study can be associated with several policy implications. First, TFP growth indeed help to boom the industrial growth through the output growth. Therefore, factor that matter for TFP growth like tehnology is particularly important. Technical workers are mostly needed by the industry. The expenditure on ICT and R&D which are much related to technological advancement seemed should be increased to enhance the output growth. Since an increase in the capital-labour ratio will increase the output growth, moving towards capital intensive is particularly help to boom this industry and this subsequently will require more high skilled workers.

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