Decomposition of Productivity Growth: The Case of Malaysian Manufacturing Sector, 1983-2000

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Abstract

This paper examines productivity growth of Malaysian manufacturing industries from 1983 to 2000. Unlike previous studies, this research uses data from two sources; Malaysian Input-Output Tables and Malaysian Industrial Manufacturing Survey to estimate productivity growth. The focus of the analysis is on the decomposition of overall TFP growth into three effects; technical change effect, inter-industry structure effect and final demand effect. The results show the final output is the largest contributor to growth in overall TFP. On the other hand, there was a substantially small contribution from technical change and particularly inter-industry structure effects. When extending the decomposition of final demand effect into price and real share effects, the results found that there was a remarkable influence of change in relative prices to the value of output share produced.

Keywords: *Total factor productivity growth, technical change, inter-industry structure, final demand.*

1. Introduction

Malaysian economy has enjoyed rapid growth in gross domestic product (GDP) for the period 1971 to 1994, averaging over 8.0%. Indeed, the rate of GDP growth had been relatively high in all Five Year Malaysia plans. However, the severe economic down-turn due to the financial crisis in 1997 had affected the growth rate fell from 7.9% in 1995-2000 to 4.5% in 2001-2005 (Malaysia, 2001; 2006). The slower rate in the Eight Malaysia Plan (2001-2005) reflects the regional economic crisis in Asia and the internal structural weaknesses in their domestic economies. For instance, Korean economy suffered from the financial crisis in 1997 after it had gone through a miracle growth for many years. This has called for the re-examination of the sources of total factor productivity (TFP) growth that have taken place in these countries and an enquary into TFP growth has become a central issue in many countries, not only in Newly Economics Countries (NECs) like Korea, Taiwan, Hong Kong and Singapore, but also in a fast growing country like Malaysia.

In analyzing productivity changes, apart from estimating growth, the more essential aspect is to identify the sources of growth in TFP. Past studies have looked into sources of productivity growth by decomposing them into many factors. Tham (1997) found that the main factors contributed positively to the growth in TFP are output, exports and foreign investment characteristics. Renuka (2001; 2002) decomposed TFP growth into technological progress and technical efficiency. Noorihsan Mohamad (2004) decomposed TFP growth into technical change and efficiency change, however his study focus on source of productivity growth in mobile telecommunications industry. Noriyoshi *et al.*, (2002) examined TFP growth in terms of foreign direct investment effects on the productivity efficiency between foreign and local firms. The study shows that foreign firms improve their productivity more than local firms. Rahmah (1999) studied the sources of growth at the firm-levels of small and medium industries (SMIs). The study found that in some industries the contribution of TFP or efficiency were still small, especially in the enterprises that are more labour intensive. Rahmah and Idris (2000) continued analyzing labour productivity growth on large-scale industries. The result found that large-scale industries gained efficiency through raising labour productivity. Mansor (1997) found that differences in TFP across states seem to persist over time. As a result, the study concludes that the convergence does not seem to be a pattern in the manufacturing productivity. Fatimah Said and Saad Mohd Said (2004) revealed that growth in TFP were high in heavy industries compared to medium and light industries. The National Productivity Corporation of Malaysia (NPC) identified five main sources of growth in TFP. These are education and training, inter-industry structure, capital structure, technical progress (include technical efficiency) and demand intensity (Productivity Report, 2005). While all the past studies that examine sources of growth of TFP approach it from the supply side, the present study will look into source of growth in TFP from the demand side, that is decomposing it into those due to inter-industry structure, technical progress and final demand intensity.

Inter-industry structure involves distribution of resources among sub-sectors and industries. The distribution implies that supply and demand for inputs through linkages between sub-sectors. The re-allocation of resources to more productive industries or sectors will lead to efficient and effective utilization of resources, and hence contribute to higher TFP growth. Apart from that, the economic reconstructed from low value-added activities to a higher value-added activities in the various economic sectors. Meanwhile, technological progress involves the effective and efficient utilization of appropriate technologies, innovation, research and development activities, positive work attitudes, good management, and organizational system. Thus, the improvement in technological progress will create higher value-added products and services.

As demand intensity comprises its' domestic and export components (for products and services), indirectly it indicates the level of productive capacity in the economy.

Improvements in productivity and quality of products and services as well as higher capacity utilization in its production and strong demand will contribute to Malaysia's export competitiveness. The economy has benefited substantially from its export-led industrialization policy in making Malaysian products more competitive in the world market.

In the Malaysian context, the contributions of foreign direct investment to the country's economic development cannot be denied. As Malaysian industrial strategies attract foreign investment through various incentives, the strategies also benefit the locals. Most foreign investments were in the manufacturing sector and in other leading sectors that lead the Malaysian economic growth. During the First Outline Perspective Plan (OPP1: 1971-1990), average growth rate of private investment in real term accounted for 9.4%, while public investment made up 10.0% (Malaysia, 1991). The total investment accounted for 35.1% of the gross national product (GNP) in real terms. The accelerated growth in this period was induced by public investment because of private investments are unable to provide impetus to economic growth due to the impact of the economic slowdown in 1985-1987. During the first six years of Second Outline Perspective Plan (OPP2: 1991-2000), private investment became the catalyst of the growth of economy, and it was up to 17.0% growth per annum. The severe economic down in 1998 had caused the foreign direct investment inflows drastically decline to 2.9% (Malaysia, 2001).

As a host country, Malaysia has intention to acquire a maximum potential from foreign investment locate in this country. As incentive given to multinational companies, Malaysia's gain economic benefit in terms of employment generation, exports expansion, technology transfer as well as GDP growth. However, the impact of technology transfer from multinational companies is quite crucial. The transfer of new technology from multinational companies may not occur to the local ones, instead of obsolete technology from advanced countries. The findings from Rasiah (1988) and Anuwar (1992b) conclude that the multinational companies' impact on the Malaysian economy can be seen in terms of growth of manufacturing output, exports, employment and technology transfer. In contrast, Fine and Harris (1985) indicated that the operations of multinational companies have designed as unique to exploited and create comparative advantage through low-wage and low-intensity production. This is in line with the study revealed by Mohd Anuar Adnan and Anuwar Ali (1990) indicated that the new technologies acquired by the multinational companies operating in Malaysia do not represent the 'state of the art' but rather the older generation of technologies already found obsolescent in the industrial countries. Findings by Rahmah *et al.,* (2006) are consistent with the latter studies that indigenous industries are less competence due to problem in the financial aspects, low-level of technology used, lack of skilled workers, and entrepreneurship. Low technological progress will hamper a creation of higher value-added products and services as well as value added related to technology-intensive used.

Apart from technological change, growth of the Malaysian economy, especially manufacturing sector can be explained by the change in inter-industry structure. Inter-industry structure among industries might be contributes to the growth in TFP. Linkage between industries, whether forward or backward is important in Malaysian industrial development, especially for key sectors in resource-based industries such as wood products and oil palm industries. In addition, the more important is linkage between resource and non resource-based industries, where most multinational companies are involved in non resource-based industries. The findings by Rasiah (1988) and Anuwar (1992b) conclude that their observations on integration between the indigenous ancillary or local supportive industries and the multi-national companies are weak.

Since independence in 1957, the importance of exports contribution to the Malaysian economy has not changed very much. However, the structure of exports contributing by sector of the economy has changed tremendously. The exports of agricultural sector, mainly raw materials of rubber and tins constituted more than 70.0% of the total exports. As shown in Table I, there is a decreasing importance in the agricultural sector in terms of its share to GDP, exports and employment. In contrast, the manufacturing sector has gained its importance in terms of average annual rate of growth, share in GDP, exports and percentage of total employment. It should be noted that, within the agricultural sector, diversification had taken place thereby enabling a reduction in the traditional importance of rubber in the 1970s to palm oil, timber and cocoa in the 1980s and 1990s. Similarly, tin's importance in the mining sector had replaced by the production of petroleum and gas.

As the Malaysia's economic growth driven from exports expansion and domestic demand, growth in manufacturing sector significantly supports by exports of manufacturing products, while domestic demand depends on the performance in domestic oriented industries. For instance, the electrical and electronics products contributed more than 70.0% of the total manufacturing export. Central Bank (2006), reports GDP is mainly driven from robust domestic demand and exports, particularly in demand for electrical and electronics, and, oil and gas products. In addition, the ratio of export to gross national product increased from 48.0% in 1983 to 68.0% 1991 and 119.0% in 2000. Thus, change in final demand (exports and domestic demand) directly will affect the total output produced by the manufacturing sector. Substantially, such shifts in final demand can directly analyze, whether it is due to change in prices or change in real output share in final demand. Therefore, it is important to link final demand with TFP, as one of determinant of growth in TFP.

In the Malaysian context, although many studies on the TFP growth have been carried out, the researchers however, looked into other different factors of TFP determinants. The present study provides a different side of view from the past studies by decomposing sources of growth in TFP into inter-industry structure and final demand without neglecting technical change as its determinant. The final demand effect also known as composition effects. This paper will follow with Section 2, which explains the input-output methodology in estimating TFP growth and decomposition aggregate TFP growth. This is followed by Section 3, deals with data collection and input-output sectoral aggregations. Section 4 presents results and discussion on TFP growth and decomposition of aggregate TFP growth. The final section presents conclusion and policy implications.

2. The Methodology

The input-output (I-O) framework provides a powerful system for the measurement of productivity growth. ten Raa and Wolff (1991), Wolff (1985b and 1994) have employed I-O accounting framework to measure growth in productivity. The framework has an advantage to study productivity growth in the whole context of the economy, by decomposing sources of TFP growth into endogenous and exogenous factors. These factors include technological change and inter-industry structure as an endogenous factor and final demand as exogenous factor. In Malaysian cases, most researchers employed standard growth accounting, namely Solow residual (Solow, 1956) in measuring TFP growth. Those who used Solow residual are Maisom and Arshad (1992), Okamoto (1994), Tham (1996;1997), Menon (1998), NPC (1999), Noriyoshi *et al.* (2002), and Fatimah and Saad (2004).

The estimation of productivity growth in the present study will be based largely on the work by ten Raa *et al.* (1984) and Wolff (1985b; 1994). In the I-O framework, industrial output is measured by gross commodity output, X, while the inputs consists of intermediate inputs (from input-output coefficients matrix), labour and capital. It is noted that intermediate inputs are classified into domestic intermediate input and imported intermediate input due to imported intermediate input has shown a large proportion of the total input. Thus, derivation of technical coefficients matrix, A will be based on input matrix of domestic intermediate input and input matrix of imported intermediate input.

The definitions of variables are given below:

$U =$ an input or 'use' commodity by industry flow matrix, where u_{ij} shows the total input of commodity i consumed by industry j;

$V =$ an output or 'make' industry by industry flow matrix, where v_{ij} shows the total output of commodity j produced by industry i;

$X = V^T 1 =$ column vector showing the gross output of each commodity i;

Where: $= V^T 1$: column vector, showing the gross output of each commodity. The superscript T refers to the transpose of the indicated matrix, $(X^1 = V1)$ is a vector whose elements are the row sums of V, showing the total 'output' of each industry; $1 =$ vector with unit entries; and V is square matrix, that is there are as many industries as commodities).

$Y = (V^T - U)1 =$ column vector of final demand by commodity;

$L_j =$ row vector of labour input, showing by total salary and wages by industry;

$K_j =$ row vector of capital input by industry;

According to ten Raa *et al.*, (1984) and, Kop Jansen and ten Raa, (1990), the matrix of technical coefficients, A should be derived from commodity technology model[1]. Wolff (1994) was also make used commodity technology model to measure productivity growth. This model has an advantage to reduce TFP growth into a sectoral or commodity level rate of productivity growth. This model assumes the number of activities must equal the number of commodities, where each industry has its own input structure, and each

[1] Also, see ten Raa et al. (1984), Viet (1986) and Kop Jansen and ten Raa (1990) for more discussion of models of secondary production and the properties of such models.

commodity produced by the same technology, irrespective of the industry of production. In addition, industries are considered independent combination of outputs j, each with their separate input coefficients A_{ij}. Moreover, in commodity technology model, prices can depend directly on the technical coefficients and are invariant with respect to changes in final demand composition, as in a standard Leontief system[2]. As shown in ten Raa *et al.*, (1984) and, Kop Jansen and ten Raa, (1990), the coefficients matrix derived by commodity technology model is given by;

$A = U[V^T]^{-1}$ = matrix of inter-industry technical coefficients

Labour and capital inputs coefficients also derived similarly;

$l_j = L[V^T]^{-1}$ = row vector of labour coefficients by industry j; and

$k_j = K[V^T]^{-1} =$ row vector of capital input coefficients by industry j.

$(j = 1,2,3, \dots, n)$;

In addition, we defined;

$p_i =$ row vector of commodity prices in industri i;

$p_j =$ row vector of output prices in industri j;

$p_t =$ row vector of prices at time t, showing the price per unit of output of each industry;

$w =$ the annual wage rate (a scalar), assumed constant across industries; and

$r =$ uniform price of capital input (average lending rate of the economy) (a scalar), also assumed constant across industries[3].

[2] This is also true for most other models of secondary production. See Kop Jansen and ten Raa (1990) for more details.

[3] In this study, the authors used average lending rate, it is implicitly assumed homogenous across industries.

$n =$ total employment (a scalar) in the economy;

$c =$ total capital stock (a scalar) in the economy;

$y_t = p_t Y_t =$ gross national product at current prices at time t.

Measurement of Sectoral Productivity Growth

The standard measure of TFP growth rate for industry j is usually defined as;

$$\pi_j \equiv -\left(\sum_i p_i da_{ij} + dl_j + rdk_j\right)\Big/ p_j \qquad (1)$$

Where: π is the corresponding row vector, and 'd' refers to proportionate change. Since for any variable$z$, $dz = z\, d\log z$, where $d\log z = \frac{d_z}{z}$ is the proportionate change in technical coefficients. This measure is a continuous version of a measure of sectoral technical change proposed by Leontief (1953).

$$\pi_j = -\left(\sum_i \alpha_{ij}(da_{ij}) - \alpha_{Lj}(dl_j) - \alpha_{Kj}(dk_j)\right) \qquad (2)$$

Where $\alpha_{ij} = p_i a_{ij}/p_j$, $\alpha_{Lj} = l_j p_j$, and $\alpha_{Kj} = rk_j p_j$. These three terms give the current value shares of the respective inputs in the total value of output. Since productivity growth rate are measured over discrete time periods rather than instantaneously, the average value share of α_{ij}, α_{Lj} , and α_{Kj} ovet the sample period is normally used to measure π (the so called Tornqvist-Divisia index). Tornqvist-Divisia estimates TFP growth using I-O based are provided in Wolff (1985b) and Jorgenson *et al.* (1987).

If we consider data at any two discrete points of time, say t and $t-1$, the growth of intermediate input can be expressed as a proportionate change in the technical coefficients. The proportionate change of intermediate inputs (da_{ij}), labour (dl_j), and capital (dk_j) are given by; $\dot{a}_{ij} = \frac{\Delta a_{ij}}{a_{ij}}$; $\dot{l}_j = \frac{\Delta l_j}{l_j}$; $\dot{k}_j = \frac{\Delta k_j}{k_j}$

$$\pi_j = -\left[\sum_i \bar{\alpha}_{ij}\dot{a}_{ij} + \bar{\alpha}_{Lj}(\dot{l}_j) + \bar{\alpha}_{Kj}(\dot{k}_j)\right] \qquad (3)$$

Aggregate TFP Growth

The commodity technology model has the added feature that aggregate TFP growth can be shown to be weighted sum of industrial or sectoral rates of TFP growth. The usual growth accounting method measures the rate of aggregate TFP growth is directly analogous to equation (1), except intermediate inputs are netted out. Then aggregate TFP growth can be defined as;

$$p \equiv [pdY - wdn - rdc/pY] \qquad (4)$$

$$\rho \equiv [\textstyle\sum_i \beta_i(dY_i) - \alpha_L(dn) - \alpha_K(dc)] \qquad (5)$$

Where $\alpha_L = wn/pY$, the wage share in total income; $\alpha_K = rc/pY$, the capital share in total income; and $\beta_j = p_jY_j/pY$, showing the share of final output j in the total value of final output. In the I-O framework, aggregate TFP growth can be related to changes in the inter-industry coefficients matrix as follows. From the Leontief balance equation;

$$Y = (I - A)X \qquad (6)$$

It follows that,

$$dY = (I - A)dX - (dA)X \qquad (7)$$

By definition, $$dn = ldX + (dl)X \quad (8)$$

$$dc = kdX + (dk)X \quad (9)$$

Substituting (7), (8) and (9) into (4) yields

$$\rho = [p(I - A)dX - p(dA)X - wldX - w(dl)X - rkdX - r(dk)X]/pY \quad (10)$$

Making use of the basic Leontief price equation $p(I - A) = wl + rk$ (11)

and substituting (11) into (10), we obtain

$$\rho \equiv -(pdA + wdl + rdk)X/pY \quad (12)$$

Then, it follows from (1) and (12) that;

$$\rho = \pi\hat{p}X/pY \quad (13)$$

Where, $\hat{p}$ = diagonal matrix of prices

Moreover, from equation (6); we have

$$X = (I - A)^{-1}Y \quad (14)$$

Note that: [$X = (I - A)^{-1}(I - UV^{-T})V^{T}1 = (I - A)^{-1}Y$; where; $Y = (V^{T} - U)1$]

Substituting this into (13) yields

$$\rho = [\pi\hat{p}(I - A)^{-1}]Y/pY$$

$$\rho = [(\pi)\hat{p}(I - A)^{-1}\hat{p}^{-1}(\hat{p}Y)]/pY$$

It then directly follows that:

$$\rho = \pi S\beta \quad (15)$$

Where, $S = \hat{p}(I - A)^{-1}\hat{p}^{-1}$, the Leontief (value) inverse coefficient matrix, showing the ringgit Malaysia value of each input used per ringgit Malaysia of output.

Decomposition of Aggregate TFP Growth

The approach of decomposition aggregate TFP growth in this study will also be based on the work by ten Raa and Wolff (1991), and Wolff (1985b;1994). As presented in ten Raa and Wolff (1991), and Wolff (1985b;1994), aggregate TFP growth can be decomposed into technical change, inter-industry structure, and final demand or composition effects.

$$d\rho = d\pi(S\beta) + \pi(dS)\beta + \pi S(d\beta) \qquad (16)$$

Where;

$d\rho =$ Change in aggregate TFP growth;

$d\pi =$ Change in sectoral rates of TFP growth (contributions of technical change);$(S\beta)$ are assumed constant;

$dS =$ Change in the Leontief inverse matrix (contribution of linkage); $(\pi\beta)$ are assumed constant; and

$d\beta =$ Change in total final demand (contribution of output shares in final demand); (πS) are assumed constant.

Price and Real Share Effect

As indicated in equation (5), β_j is the value share of the final output of sector j in the total value of final output. Thus, change in β_j reflect both changes in relative prices and changes in the share of real final output j in real total final output. As presented in Wolff (1985b), the composition effects/final demand effects can be decomposed into price and a real share effect as;

Relative prices are deflated using the gross national product deflator;

$$\sigma_{it} = \frac{p_{it}}{p_t Y_t / p_0 Y_t} = \frac{p_{it} . p_0 Y_t}{y_t}$$

Where σ is a row vector and p_0 is the vector of prices in the base year of 1978. The real final output share vector δ is defined as;

$$\delta_{it} = p_{i0}Y_{it}/p_0Y_t = Y_{it}/p_0Y_t$$

Where, sectoral base year prices are set equal to unity. Then;

$$\beta_{it} = \sigma_{it}\delta_{it}$$

And,

$$\Delta\beta \cong (\Delta\hat{\sigma})\delta + \hat{\sigma}(\Delta\delta) \qquad (17)$$

3. Data Collection and Input-Output Sectoral Aggregations

This study utilizes data from Malaysia's Input-Output Tables and Industrial Manufacturing Survey (IMS). As methodology is based largely on the ten Raa and Wolff (1991), and Wolff (1985b;1994), a few minor modifications on data will be made in order to strengthen this work. This work is the first attempt in measuring growth in TFP by using input-output data incorporating with data from the IMS. This is because, all past studies on TFP growth in Malaysia had utilized data from IMS *per se*. (Maisom and Arshad,1992; Tham, 1995;1997; Menon, 1998; Noriyoshi *et al.*, 2002; Renuka, 2001; 2002; Fatimah Said and Saad Mohd Said, 2004).

This study employs data for 1983, 1987, 1991 and 2000 of Malaysia's Input-Output Tables published by Department of Statistics (DOS). Based on these data, this study has classified into three sub-periods; 1983-1987, 1987-1991 and 1991-2000. Capital and labour are unpublished data presented by industry obtained from IMS also taken from DOS. Total salary and wages are used as labour input, and capital stock measures by the net fixed asset as at 31 December (gross fixed asset - depreciation rate + gross fixed capital formation/capital expenditure). Fixed asset, which present capital input consists of building and other construction, machinery equipment, transport equipment, and information communication technology's tools such as computer. Both data classified at three digit-level of industrial aggregation according to Malaysian Industrial Classification (MIC) have to correspond with Input-Output Industrial Classification. This study used Producer Prices Index (PPI) for local production by commodity group of Standard International Trade Classification (SITC) to deflate some of the variables to reflect the real change in the variables. Deflators of PPI is derived from weighted prices indices by using two digit-level of commodity group (SITC) and for 'other sectors' used PPI of the domestic economy, which is based on 1978 as its base year.

In terms of input-output sectoral aggregations, the existing framework of national income account classification has governed the potential maximum size of the Malaysia's Input-Output Tables. Two sets of basic tables are namely as 'make' and 'use' table published by DOS were presented at the 60 by 60 level of commodities/industries aggregation. However, this study reduced the tables to 32 by 32 industries/commodities, covering all 31 manufacturing industries/commodities and single sector which represent the 'other sectors' that includes the services, agriculture, mining and construction, and the rest of public sectors.

4. Results and Discussion

The results of TFP estimates from this study are expected different from data compiled by IMS *per se*. The use of data from input-output table which incorporates data from IMS makes this study different from other studies. Moreover, input-output approach is partly considered as general equilibrium analysis. Therefore, results of this study most probably will be different from results of many other researchers of TFP study in Malaysia. This is because, research on TFP study in Malaysian cases merely used cross-section data from the IMS. Table II presents the average annual rate of growth in TFP for the 31 sub-sectors over the three sub-periods of 1983-1987, 1987-1991 and 1991-2000. From the table, TFP growth estimates from this study were registered at 4.5%, 2.2% and 1.9% over three sub-periods of the study. These results are different from other studies [Okamoto (1994); Maisom, Mohd Ariff and Nor Aini (1993); Tham (1997); NPC (1999), and Noriyoshi *et al.* (2002)]. Results of TFP measures were also different among past studies. This is because, different methods, different sources of data, different procedures of data computation, different aggregation of industrial sector, different years covered in the study and so forth, definitely yield to a different result on TFP estimation. Moreover, Tham (1996) pointed that it is not surprising as different sources of data and methods of computation will definitely yield different results for TFP measures. Wong (1995) also reported that different results yield from different studies on TFP in Singapore.

As shown in Table II, it can be seen that the range of annual rate of TFP growth between these sub-sectors can be quite broad with the manufacture of rubber processed attaining a rate of growth of 21.6%, while the manufacture of other transport equipment is at the other end of the spectrum, that is -17.7% over the period 1983-1987. The period

1987-1991 exhibits the manufacture of preserved food at a rate of 23.9%, while the manufacture of grain mills was at -16.7%. Lastly, the period 1991-2000 presents the manufacture of non-electrical machinery industry, which was at 10.0%, while meat and dairy products at -3.3%.

In terms of performance by industry, there are 71.0% sub-sectors of the manufacturing sector show positive annual rate of TFP growth during the period 1983-1987 and 1991-2000. After economic recession in 1985, the figure accounted for below than 50.0% during 1987-1991. The number of industries showing growth in TFP had decreased due to economic recession in 1985. It accounted for 48.4% during the period 1983-1987. Apart from that, over three sub-periods, the results show that only 8 sub-sectors (25.8%) out of the 31 sub-sectors of the manufacturing sector had a positive growth in TFP. These are sub-sectors of tobacco, wearing apparel, furniture and fixtures, rubber industries, plastic products, other metal products, non-electrical machinery and other manufacturing products. The rest of 74.1% sub-sectors showed inconsistent growth in TFP, with positive and negative rates.

Decomposition of Aggregate TFP Growth

The main aim of this part is to analyse the decomposition of overall TFP growth into three effects, corresponding to the three terms on the right hand side of equation (16). The first of these is the 'sub-sectoral technical change effect' $(\Delta\pi)$ shows the change in overall TFP growth that would occur if S (inter-industry multiplier effect) and β (final demand shares) remained constant but sub-sectoral rates of TFP growth changed as they had in actuality. The second is the 'inter-industry multiplier effect' shows the change in overall TFP growth that occur if technical change $((\pi)$ and final output shares (final demand shares) (β) remained constant but the inter-industry matrix S changed. Change in S stems from change in the Leontief inverse matrix. This term reflects, in part, changes in linkage patterns among subsectors. The third is the 'output shares' or 'composition effect' $(\Delta\beta)$, which shows how much overall TFP growth would have changed if sub-sectoral technical change and inter-industry structure had remained constant over time but the composition (value) of final output changed as it did in actuality. Moreover, it is also apparent that the three effects isolated in equation (16) are not independent.

As shown in Table III, the overall rate of TFP growth inclined from -16.8% per year to 13.3% per year over the period of 1983-1987 and 1987-1991, while for the 1991-2000 periods, it averages 23.7% per annum. Hence, the change in annual TFP growth between two periods is 30.1% and 10.4%.

Table IV presents decomposition results of the change in aggregate TFP growth. Since discrete time periods were used, the average value of β in the time period, $\bar{\beta}$, was used in place of β in (20), and the average values of matrix S in the period, $\bar{S}$, in place of S. In addition, both first period and last period weights for $\bar{\beta}$ were used in the decomposition from (21). The change in β over two sets of time periods was considered: 1983-1987/1987-1991 and 1987-1991/1991-2000.

The change in the overall TFP between 1983-1987 and 1987-1991 periods inclined from -16.8% to 13.3% per annum, or by 150.4 percentage points. The first of decomposition as mentioned above is the sub-sectoral TFP growth effect, resulting from the change in sub-sectoral rates of TFP. This accounts for 11.3% of the incline in overall TFP growth. The second is the inter-industry multiplier effect, from a change in matrix S. It is small, accounting for -0.3 of the incline. The third is the final output or composition effect. It accounts for 89.0% of the overall change in productivity.

The change in the overall TFP between 1987-1991 and 1991-2000 periods inclined from 13.3% to 23.7% per annum, or by 170.1 percentage points. The first component of result shows technical change effect (sub-sectoral TFP growth effect) contributing 19.7% to the incline in overall TFP growth. The second component remained the same. It is small, accounting for -1.0% of the incline. As a result, the component of final output value shares remained large, contributing for 82.3% of the incline in overall TFP growth.

Results from both periods of overall change in TFP growth show that the component of final output was larger, contributing above than 80.0% of the inclined in TFP growth. This reflects that final output component is important in determining overall change in TFP growth. As shown in Table V, the final output component is above 70.0% of total output (gross output) for the year 1983, 1987, 1991 and 2000. The major advantage of using final output in this study is the change in aggregate TFP growth is related to the shift in final output Moreover, final output shifts are usually held to be autonomous (or exogenous to the system), since they reflect changes in consumer taste and demand patterns. In contrasts, change in gross output shares may be partly due to changes in the inter-industry matrix S, which is considered an endogenous or a derived effect. Therefore, based on the reason, Wolff (1994) suggests change in final output shares, methodologically closer to a ‘pure’ composition effect than the change in gross output shares.

Past study by ten Raa and Wolff (1991) on TFP growth estimates using the United States I-O data covering 85 sectors over the period 1967, 1972 and 1977. The empirical results of the study indicated the largest contribution to the change in overall TFP growth was technical change effect (sub-sectoral TFP growth effect), accounting for 85.0% and 90.0% between the periods 1967-72 and 1972-77. Wolff (1985b) obtained 99.4% and 99.8% contribution of technical change effect of the decline in TFP growth for 1958-67 and 1967-76 periods, and 97.7% for the period 1947-76 (Wolff, 1994). On the other hand, both studies had shown value shares of final output was only 12.0%, 11.1% (ten Raa and Wolff (1991), and 5.2% and 5.4% (Wolff, 1985b), and 6.3% (Wolff, 1994) respectively.

The results from this study are different from the results obtained by ten Raa and Wolff (1991) Wolff (1985b), and (Wolff, 1994). The three studies obtained technical change effect as the largest contribution to the overall change in TFP growth, while final output shares were relatively small. Inter-industry effect however, indicated negative contribution. In their study, the value share effect was largely offset by the inter-industry effect. On the other hand, for the Malaysian cases, as rapid growth developing countries, the contribution of technical change was very small. This reflects that the production structure of Malaysian economy, in terms of technological progress had a small change, which is in the range of 10.0% to 20.0% from 1983 to 2000 periods. From this evidence, it is convincing to say that in certain industries in the manufacturing sector, there might have been no progress of technological change.

However, the contribution of final output shares to change in overall TFP was large. This may imply that final demand component determined the contribution to the change in overall TFP growth. In a study by Rohana, Zakariah and Kamaruzaman (2008), most of sources of growth for the key sectors in 1978-1991 came from final demand, especially domestic demand expansion. Apart from that, several key sectors such as vegetable, fruits, sawmills and furniture and fixtures dominated by export demand expansion. Zakariah and Ahmad (1999) also met the same conclusion indicate that domestic-demand expansion was the dominant source of growth in the Malaysian economy in the sub-period 1978-83, while exports expansion was dominant in light and heavy industry.

In terms of interindustry effects, this study revealed that linkage patterns among industries were negative during both periods of the study. This may imply that linkages/inter-industry structure did not contribute to growth in TFP. The characteristic of multi-national companies usually bring together their subsidiaries companies into the host country for the purpose to supply part and components to the leading companies, hampered linkages between resources and non resource-based industries. This may reflects that linkages between industries may occur only among the local firms, but linkages between local and foreign firms might not exist in general. In addition, the characteristic of multinational companies in Singapore that are engaged in processing industries, which import unfinished component and export finished products result in weak intra-manufacturing linkages or linkages with non-manufacturing sectors, while linkages within the multinationals' network of plants located throughout the world tend to be stronger (Tsao, 1985).

Price and Real Share Effects

The extension of composition effects can further be decomposed into real share effects and price effects. As mentioned before, the value share of the final output of sector j in the total value of final output indicated by (β_j) can reflect relative price change and real shares change. First is price effects, which shows how much overall TFP growth would have changed if real final output shares had remained constant but prices changed as they did between 1983-87 and 1987-91; and 1987-91 and 1991-2000. This effect shows, out of 89.0%, only 4.6% was attributable to price changes between 1983-87 and 1987-1991. In the second period of 1987-97 and 1991-2000, there was an increasing trend in price effects. However, it was relatively small, accounting for only 12.6%.

The second is the real share effects which shows how much overall TFP growth would have changed if real final output shares shifted (as they did between 1983-87 and 1987-91; 1987-91 and 1991-2000), but the relative prices of 1983-87 had remained unchanged. As presented in Table VI, the real share effects accounted for about 84.4% and 68.7% of the change in overall TFP growth in the both periods respectively. The primary reason for this is that changes in real final output shares for both periods were uncorrelated with sectoral productivity growth due to final output is exogenous variable in the input-output model. From both effects, it can be seen that price effects and real share effects are positively related. This reflects that increase in relative price will increase production by producers due to larger final demand of exports and domestic demand expansion.

5. Conclusion and Policy Implications

This study concludes that Malaysian overall TFP growth was contributed mainly from the exogenous influence of the economy's final demand, comprising exports and domestic demand while technological change played a small role. However, foreign direct investment did play an important role. Endogenously, technical change and inter-industry structure contribute a small fraction to the overall TFP growth. Based on the past performances of its overall TFP growth, potentially, the economy can enhance its overall TFP growth by managing its domestic and exports demands, which can be done through some combination of monetary and fiscal policy measures. This also implies that although the economy is known to be a small open developing economy, yet it has significant control on the economy in determining its overall TFP growth. From policy view point, the economy's relative size and structure of private consumption expenditure can be used to influence its overall TFP growth.

Similarly, as a leading export country and since export expenditure can significantly influence the economy overall TFP growth, export promotion activities in terms of increasing the volume and the dispersion of export destinations should be used actively. This can be done through normal measures of export promotion. However, it is important to note that export expenditure by foreign buyers is somewhat autonomous and if export markets face difficulty there is very limited measure by to rectify it except in the long run by diversifying the export destinations. Undoubtedly, foreign direct investment plays an important role in terms of contributing to exports.

Apart from its contribution to exports, multinational companies transfer their technology to the host countries, which in addition to the local indigenous research and development activities will strengthen its contribution to the overall TFP growth. Captured by the contribution of inter-industry structure, contribution of technological change to overall TFP growth is still very limited. But, enhancing inter-industry structure, creating stronger inter-sectoral linkages, which is currently visible only in the economy's resource-based industries should be extended to the non-resource based industries as well. Perhaps, the country's industrial policy review should give more focus on the strengthening inter-industrial linkages, especially among the non-resource based industries, that is improving linkages between multinational companies and their local vendors. Last but not least, our empirical results, showing that change in real share effects is more significant than change in price effects supports the important role of final demand in affecting overall TFP growth.

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Table I   Changes in Economic Structure, 1970-2005

	Average annual growth rate (%)				Share of GDP (%)					Share of export (%)					Share of employment (%)				
	1970-79	1980-89	1990-99	2000-05	1970	1980	1990	2000	2005	1970	1980	1990	2000	2005	1970	1980	1990	2000	2005
Agriculture	6.1	4.2	2.2	3.8	32.3	24.6	15.2	8.8	8.7	60.2	43.8	22.3	6.1	7.0	69.5	39.7	26.0	18.3	14.6
Mining	8.6	5.9	8.5	2.3	5.8	4.6	11.8	10.9	15.2	26.4	34.3	17.8	7.2	9.8	3.4	1.7	0.6	0.3	0.4
Manufacturing	16.0	8.8	12.1	4.2	12.3	19.2	24.2	32.6	30.5	12.2	21.1	59.3	85.2	80.5	14.0	15.7	19.9	22.8	19.8
Construction	9.1	2.1	11.9	0.4	4.5	4.8	3.6	3.3	3.1	-	-	-	-	-	1.8	5.6	6.3	8.6	9.0
Services	9.3	7.6	12.8	6.3	45.0	46.8	46.4	48.3	46.2	-	-	-	-	-	11.3	37.3	47.2	50.0	56.2
Others[1]										1.2	0.8	0.6	1.5	2.7					

Source: Malaysia (2006): Statistics-Time Series 2005 (Annual growth rate); Bank Negara Report, *various years* (share of export); DOS, Labour Force Survey, *various years* (employment); Economic Report, *various years*

Note: [1] includeforestry.

Table V   Share of Intermediate Input and Final Demand from the Total Output (%)

Industry	1983		1987		1991		2000	
	Intermediate input	Final demand	Intermediate input	Final demand	Intermediate input	Final demand	Intermediate input	Final demand
1. Meat and dairy products	19.3	80.7	19.7	80.3	20.4	79.6	44.4	55.6
2. Preserved food	5.2	94.8	5.5	94.5	12.0	88.0	20.7	79.3
3. Oils and fats	48.4	51.6	48.9	51.1	49.1	50.9	58.0	42.0
4. Grain mills	29.8	70.2	27.9	72.1	41.4	58.6	56.2	43.8
5. Bakeries and confectionary	6.5	93.5	5.5	94.5	6.3	93.7	16.6	83.4
6. Other foods production	33.1	66.9	32.6	67.4	37.5	62.5	40.0	60.0
7. Animal feeds	95.6	4.4	107.5	-7.5	108.1	-8.1	95.8	4.2
8. Beverages	12.5	87.5	12.5	87.5	14.3	85.7	25.1	74.9
9. Tobacco	2.1	97.9	8.4	91.6	9.4	90.6	4.8	95.2
10. Textiles	37.0	63.0	31.4	68.6	25.7	74.3	32.6	67.4
11. Wearing apparel	15.2	84.8	9.1	90.9	7.1	92.9	10.9	89.1

12. Sawmills	49.8	50.2	37.3	62.7	25.4	74.6	27.0	73.0
13. Furniture and fixtures	7.2	92.8	10.1	89.9	8.8	91.2	11.0	89.0
14. Paper and printing	72.3	27.7	66.3	33.7	74.4	25.6	58.5	41.5
15. Industrial chemicals	54.8	45.2	37.7	62.3	31.4	68.6	47.0	53.0
16. Paints and lacquers	93.9	6.1	49.4	50.6	64.7	35.3	45.1	54.9
17. Other chemical products	36.1	63.9	27.9	72.1	27.8	72.2	38.2	61.8
18. Petroleum and coal	57.1	42.9	34.2	65.8	55.3	44.7	45.2	54.8
19. Rubber processed	4.8	95.2	5.3	94.7	12.9	87.1	1.5	98.5
20. Rubber industries	33.1	66.9	27.7	72.3	19.7	80.3	23.2	76.8
21. Plastic products	50.0	50.0	56.0	44.0	53.1	46.9	23.6	76.4
22. China, glass and clay	66.6	33.4	62.4	37.6	63.0	37.0	56.7	43.3
23. Cement, lime and plaster	93.8	6.2	93.3	6.7	94.5	5.5	90.5	9.5
24. Other non-metal mineral	88.0	12.0	94.3	5.7	85.4	14.6	87.1	12.9
25. Basic metal products	49.6	50.4	57.6	42.4	62.7	37.3	56.8	43.2
26. Other metal products	68.5	31.5	77.6	22.4	43.7	56.3	72.1	27.9
27. Non-electrical machinery	45.1	54.9	45.5	54.5	29.1	70.9	4.9	95.1
28. Electrical machinery	11.7	88.3	3.6	96.4	14.7	85.3	11.2	88.8
29. Motor vehicles	17.0	83.0	19.4	80.6	24.4	75.6	32.0	68.0
30. Other transport equipment	15.1	84.9	40.1	59.9	53.0	47.0	47.2	52.8
31. Other manufacturing	22.4	77.6	13.6	86.4	14.2	85.8	18.4	81.6
32. Other sectors	35.2	64.8	37.9	62.1	37.9	62.1	40.8	59.2
Number of subsectors Percentage of subsectors of the manufacturing sector	9 (29.0)	23 (74.2)	8 (25.8)	24 (74.4)	10 (35.3)	22 (71.0)	9 (29.0)	23 (74.2)
Average Shares (%)	39.9	60.1	37.7	62.3	38.4	61.6	38.8	61.2

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

Table II Annual Rate of TFP Growth by Industry of the Manufacturing Sector and Other Sectors, 1983-2000 (%)

Industry	1983-1987 (1)	1987-1991 (2)	1991-2000 (3)
1. Meat and dairy products	-4.6	15.1	-3.3
2. Preserved food	1.6	23.9	-3.2
3. Oils and fats	-2.9	-7.8	0.8
4. Grain mills	-0.9	-7.2	0.6
5. Bakeries and confectionary	10.8	-9.3	2.2
6. Other foods production	0.8	-5.6	1.6
7. Animal feeds	0.9	19.4	-2.1
8. Beverages	4.4	-7.8	6.1
9. Tobacco*	6.4	21.2	0.9
10. Textiles	6.1	-3.7	-0.6
11. Wearing apparel*	16.6	0.9	1.0
12. Sawmills	6.9	-7.1	-1.5
13. Furniture and fixtures*	2.9	18.9	3.8
14. Paper and printing	5.8	-2.2	2.3
15. Industrial chemicals	19.1	-3.4	-0.6
16. Paints and lacquers	-2.4	1.4	4.2
17. Other chemical products	6.3	-2.7	5.9
18. Petroleum and coal	-11.6	-7.2	5.4
19. Rubber processed	21.6	-16.7	1.7
20. Rubber industries*	0.8	1.0	3.5
21. Plastic products*	9.2	1.0	3.2
22. China, glass and clay	-5.5	6.1	5.5
23. Cement, lime and plaster	2.0	-6.2	0.5
24. Other non-metal mineral	3.3	-0.9	-1.2
25. Basic metal products	-2.6	-7.6	-0.2
26. Other metal products*	0.4	5.8	0.5
27. Non-electrical machinery*	7.3	11.9	10.0
28. Electrical machinery	20.2	15.4	-1.0
29. Motor vehicles	-17.0	16.3	0.6
30. Other transport equipment	-17.7	-1.2	1.2
31. Other manufacturing*	19.5	5.1	1.7
Numbers of sub-sectors with positive rate of TFP growth	22 (71.0%)	15 (48.4%)	22 (71.0%)
32. Other sectors	3.4	-4.3	1.4
Weighted average annual rate of TFP growth (Manufacturing Sector)	4.5	2.2	1.9
Weighted average annual rate of TFP growth (Total Economy)	3.8	-1.3	1.7

Note: i. Positive sign shows growth in TFP and vice versa.
ii.* indicates industry with growth in TFP over three sub-periods of the study.

Table III Annual rate of overall TFP growth

	Periods		
	1983-1987	1987-1991	1991-2000
Annual rate (%)	-16.8	13.3	23.7
Periods	Change (%)		
1983-1987/1983-1987	30.1		
1987-1991/1991-2000	10.4		

Table IV Decomposition of the Change in Overall Productivity Growth

Periods	Percentage contribution				
	Overall $\Delta\rho$	Technical change $(\Delta\pi)S\beta$	Inter-industry structure $\pi(\Delta S)\beta$	Output shares $\pi S(\Delta\beta)$	Sum of three effects
1983-1987/1987-1991	1.5044	11.3	-0.3	89.0	100.0
1987-1991/1991-2000	1.7009	19.7	-1.0	81.3	100.0

Note: Estimation output shares is based on final output.

Table VI Decomposition of price and real share effects

	Overall $\Delta\rho$	Price effect $(\Delta\hat{\sigma})$	Real share effect $(\Delta\delta)$	Total Value Share $(\Delta\beta)$
1983-87/1987-91	1.5044	0.0697 (4.6)	1.2690 (84.4)	1.3387(89.0)
1987-91/91-2000	1.7009	0.2148 (12.6)	1.1688 (68.7)	1.3836 (81.3)