Jurnal Ekonomi Malaysia 47(1) 2013 65 - 74

Decomposition of Productivity Growth of the Malaysian Manufacturing Sector, 1983-2005

(Pencerakinan Pertumbuhan Produktiviti Sektor Pembuatan Malaysia, 1983-2005)

Noorasiah Sulaiman
Faculty of Economics and Management
Universiti Kebangsaan Malaysia

Zakariah Abdul Rashid
Malaysian Institute of Economic Research (MIER)

ABSTRACT

The present paper examines the productivity growth of Malaysian manufacturing industries between 1983 and 2005. Unlike previous studies that use one source of data, the present study uses two sources of data:the Malaysian Input-Output Tables and the Malaysian Industrial Manufacturing Survey. The analysis focuses upon on the decomposition of aggregate total factor productivity (TFP) growth into three effects: technical change, linkage and final demand. The findings indicate that final demand is the largest contributor to growth in overall TFP. In addition, a small contribution stems from technical change and particularly linkage effects. When the decomposition of final demand effect is extended into price and real share effects, the findings obtained demonstrate that a change in relative prices significantly influences the change in output share produced.

Keywords: Total factor productivity growth; technical change; linkage structure and final demand

ABSTRAK

Artikel ini mengkaji pertumbuhan produktiviti sektor pembuatan Malaysia dari tahun 1983 hingga 2005. Tidak seperti kajian terdahulu yang menggunakan satu sumber data, kajian ini menggunakan dua sumber data, iaitu data Jadual Input-Output Malaysia dan data Banci Industri Pembuatan. Fokus analisis bagi kajian ini ialah terhadap pencerakinan produktiviti fakto rkeseluruhan (TFP) terhadap tiga komponen, iaitu perubahan teknik/ teknologi, struktur inter-industri/ rantaian dan permintaan akhir. Dapatan kajian menunjukkan komponen permintaan akhir adalah penyumbang terbesar kepada pertumbuhan TFP. Sementara itu, sumbangan yang kecil daripada perubahan teknik/ teknologi dan khususnya, struktur inter industri/ rantaian. Analisis lanjutan terhadap pencerakinan permintaan output akhir kepada perubahan harga dan perubahan output benar mendapati wujud pengaruh yang signifikan bagi perubahan dalam harga relatif terhadap perubahan dalam jumlah output yang dikeluarkan.

Kata kunci: Produktiviti faktor keseluruhan; perubahan teknik; struktur rantaian dan permintaan akhir

INTRODUCTION

A number of extant studies estimate total factor productivity (TFP) in an effort to measure TFP growth in Malaysia, particularly in regards to the manufacturing sector. In Malaysia, a number of studies measure TFP growth with the objective of identifying the sources of growth in TFP, particularly in the manufacturing sector. Extant literature examines growth in TFP by decomposing the output growth into the contribution of input growth,including factors such as intermediate inputs, labour and capital input (Maisom and Arshad 1992; Tham and Choong 1995; Tham 1996, 1997). Several studies examine the contribution of growth in TFP by decomposing the growth in TFP into technical change and technical efficiency (Rahmah 1999; Renuka 2001, 2002; Idris 2007). Based on the findings from extant research, the growth of the Malaysian manufacturing sector is governed by input-driven growth, rather than productivity-driven growth, which leads to a low level of growth in TFP.

Apart from technical change, growth in TFP can also be explained by other sources, which include the elements relating to education; training; the structure of linkage; and demand intensity. Such elements are recognized as main sources of growth in TFP by the Malaysian Productivity Corporation of Malaysia (MPC 2006). Therefore, the present study is motivated to examine the contribution of structure of linkage and demand intensity to growth in TFP,since the contributions of such sources are not investigated in extant literature. Linkage, which involves the distribution of resources among sub-sectors or industries, relates to the supply and demand for inputs between industries. The re-allocation of resources to more productive industries or sectors leads to an efficient and effective utilization of resources, and, hence, contributes to increases in economic growth (MPC 2006). Linkage between industries, whether forward or backward, is important in Malaysian industrial development. This is particularly true in the case of the manufacturing sector, which includes key sectors in resource-based industries that rely on domestic inputs, such as for wood products and the oil palm industry

Demand intensity, which is comprised of domestic and export components (for products and services), can be examined by final output demand. The variable indirectly indicates the level of productive capacity in the economy. Improvements in productivity and the quality of products and services, as well as higher capacity utilization during production and strong demand, will contribute to the export competitiveness of Malaysian industries. Since the Malaysian economy has benefited substantially from its export-led industrialization policy, the contribution of exports from the manufacturing sector to the Malaysian economy is very important. Furthermore, shifts in final demand can be directly analysed to determine whether such shifts are the result of a change in prices or a change in the real output share in final demand. Therefore, it is important to examine the link between final demand and TFP, as one of the determinants of growth in TFP.

Since economic growth in Malaysia is driven by exports expansion and domestic demand, growth in the manufacturing sector is significantly supported by exports of manufacturing products, while domestic demand depends upon the performance of domestic oriented industries. For instance, electrical and electronic products contributed to more than 70.0% of total manufacturing exports. Reports from the Central Bank (2007) indicate that the Malaysian gross domestic product (GDP) is mainly driven by robust domestic demand and exports, particularly the demand for electrical and electronic products; and petroleum products. In addition, the ratio of exports to gross national product (GNP) increased from 48.0% in 1983 to 68.0% in 1991, increasing further to 119.0% in 2000. Thus, the change in final demand (exports and domestic demand) directly affects the total output produced by the manufacturing sector.

With regard to the above issue, the objective of the present study is to identify the contribution of linkage/inter industry structure, final output demand and technical change to the growth in TFP in the manufacturing sector by employing decomposition methods. Furthermore, by using the methods, the present study is able to fill existing gaps in extant literature. Moreover, the main data from input output tables are able to provide a different view ofthe contribution of TFP by considering supply and demand in relation toinputsin order to examine the structure of linkage; and the approaching the variable of final demand as a demand for output. The approach differs from previous studies that utilise different methods; and data solely obtained from surveys of the manufacturing sector (Okamoto 1994; Tham 1996, 1997; Menon 1998; Noriyoshi et al. 2002; Fatimah and Saad 2004; Idris 2007).

The remainder of the present paper is structured as follows. Section two provides the literature review. Section three outlines the use of input-output methodology in estimating TFP growth and the decomposition methods of TFP growth. The sources of data and input-output aggregation procedures are also presented. Section four presents the results and discussion regarding TFP growth and the decomposition of TFP growth. Finally, section five concludes the study.

LITERATURE REVIEW

The initial study by Maisom and Arshad (1992) analyses the growth in TFP in the Malaysian manufacturing sector during the period of 1973 to 1989. The study determines that the growth in TFP is negative during the period and that the contribution from the manufacturing output growth to TFP is low during the period. Another study finds that the rate of TFP is positive for the period between 1986 and 1990, but is also rather low (Tham and Choong 1995). The study also concludes that intermediate inputs are a major source of growth to manufacturing output during the periods examined. Tham (1996, 1997) continuesby re-estimating the growth in TFP and finds that the growth in TFP for the manufacturing sector is substantially low at 0.3 per cent for the period between 1986 and 1991. Furthermore, the primary source of growth in the manufacturing sector is derived from the growth of non-energy intermediate inputs, which demonstrates that the Malaysian manufacturing sector is still dependent upon input growth. However, the growth in TFP for the overall economy is found to be negative during the period examined. The study extends further examine the determinants of productivity growth by utilising the ordinary least squares (OLS) procedure, taking into account trade policies and industry characteristics. The findings reveal that the main factors that contribute positively to the growth in TFP are the rate of change in output; the rate of change in exports; and the characteristics of foreign investment.

The study performed by Okamato (1994) is similar to those of Tham (1996, 1997). However, the difference is that Okamoto examines the impact of trade and foreign direct investment (FDI) liberalization policies on productivity growth in the manufacturing sector. Surprisingly, the findings of Tham (1996, 1997) and Okamato (1994) are similar, concluding that the rate of TFP growth of the manufacturing sector was 0.3 per cent for the period between 1986 and 1990. However, the estimation of TFP growth at the sector level is not presented in Okamoto's study. The examination of the effects of FDI on TFP growth is continued by Noriyoshi et al. (2002). However, this study differs from the studies of Okamoto (1994) and Tham (1996,1997) as the study performs a comparison between foreign firms and domestic firms; and examines the aggregate level of TFP growth. The findings show a wide variation of FDI effects on the productivity between foreign and local firms for the period between 1992 and 1996. For the aggregate level of TFP growth, the study finds that productivity was improved at a higher rate among foreign firms than local firms, both at the three and five digit levels of industrial classification.

Menon (1998) examines the productivity performance of domestic and foreign firms in the manufacturing sector. The study is comprised of foreign and domestic firms in 53 subsectors of manufacturing for the period between 1988 and 1992. By using a growth accounting procedure, an estimation of the TFP growth is provided using industry-level data from discrete time intervals. The findings are similar to those of Tham and Choong (1995), whereby it is found that the growth in real manufacturing output is driven by input growth, the principal intermediate input for both domestic and foreign firms. Fatimah and Saad (2004) estimate the growth in TFP in heavy and light industries, and find that heavy industries have a higher growth in TFP compared to light industries. However, the average rate of growth in TFP is found to be negative for the period between 1982 and 1986, but positive for the period between 1987 and 1997.

Renuka (2001) decomposes thegrowth in TFP to identify the sources of growth using stochastic frontier analysis (SFA). The method estimates the production function using panel data comprised of 28 subsectors of the manufacturing sector for the period between 1981 and 1996. The estimation of output growth is then decomposed into the contribution of input growth, while further extending the decomposition of the TFP growth into technical progress and technical efficiency. Instead of gross output, the value-added is used as an output measure. The results show that the Malaysian manufacturing sector is highly dependent on input growth and that it is positively biased towards skilled labour.

Utilizing the same data on a different model to measure the growth in TFP, the results of the data envelopment analysis (DEA) model are compared to the results of the SFA (Renuka 2002). The DEA shows that the growth in TFP is consistently positive, while the SFA is consistently negative during the period examined. The SFA model shows that the growth in output is mainly driven by input rather than productivity. Although the results from both models are different, the growth in TFP is generally quite low and sometimes negative. Idris (2007) supports the conclusion that the low growth in TFP is due to the negative contribution of technical efficiency in the Malaysian economy based upon data for the period between 1971 and 2004. By using panel data, the study reveals that the Malaysian economy is able to shift its own frontier due to innovation and concludes that the presence of foreign companies in Malaysia is a major contributor to the growth in TFP. A related study confirms the findings that the contribution of efficiency are rather small in some subsectors of the manufacturing sector, especially in industries that are more labour-intensive (Rahmah 1999).

THE METHODOLOGY

The present study employs the input-output (I-O) methodology because data from the Malaysian Input-Output Tables are utilized. The present study marks the first attempt to measure growth in TFP by using the input-output data of Malaysia, combined with data from the Industrial Manufacturing Survey (IMS).Therefore, the present study differs from all previous studies examining TFP growth that utilize data of cross-section *per se,* which allows the analysis by using growth accounting methods and econometrics models (Maisom and Arshad 1992; Tham 1996, 1997; Menon 1998; Noriyoshi et al. 2002; Renuka 2001, 2002; Fatimah and Saad 2004; and Idris 2007). By employing the I-O methodology, which allows for the utilisation of Malaysian input-output data, the present study is able to examine the contribution of linkage and final output demand to growth in TFP of the manufacturing sector. The I-O method has an advantage when analysing the endogenous sources of TFP growth (i.e technical change and inter-industry structure) the exogenous factor of final demand.

THE MODEL

The estimation of productivity growth in the present study will be based largely on the study by Raa et al. (1984), Wolff (1985, 1994), and Raa and Kop Jansen (2004). In the I-O framework, industrial output is measured by gross commodity output, X, while the inputs consist of the intermediate inputs (from input-output coefficients matrix) of labour and capital. In the present study, select variables are modified in order to improve the model and obtain more representative results, which differ from past studies (e.g. Wolff 1985, 1994). First, intermediate input isin light of two variables: domestic intermediate input and imported intermediate input. This is because imported intermediate input represents a large proportion of the total input for the Malaysian case, while Wolff (1985, 1994) only considers total input. Second, instead of annual wages that are assumed constant/homogenous across industries, the present study uses total salary and wages by industry to represent the contribution of labour that is expected different among the various industries in the manufacturing sector. Third, the average lending rate of the economy is used as a uniform price of capital input is assumed constant across the industries (authors use the average lending rate, which is implicitly assumed to be homogenous across industries). The computation of the lending rate is based upon the monthly information from January to December of a particular year.

Based on the I-O methods, the present study derives the matrix of technical coefficients, A, using the input matrix of domestic intermediate input and the input matrix of imported intermediate input.

The definitions of the variables are as follows:

U = an input or 'use' commodity by industry flow matrix, where u_{ij} shows the domestic/imported 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 a square matrix, which reflects the existence of as many industries as commodities.

$X = (V^T - U)1$ = column vector of final demand by commodity;
X = row vector of labour input, shown by total salary and wages by industry;
X = row vector of capital input by industry.

The matrix of technical coefficients, A, is derived from the commodity technology model (Raa et al.(1984), Viet (1986) and Kop Jansen and Raa (1990) for more discussions on models of secondary production and the properties of such models), which has an advantage in reducing TFP growth into a sectoral level rate of productivity growth (Wolff 1985). In addition, the model assumes that the number of activities must equal the number of commodities, where each industry has its own input structure, and each commodity is produced by the same technology, irrespective of the industry of production. In addition, industries are considered as an independent combination of outputs, j, each with their separate input coefficients A_{ij}. Moreover, in the 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 (this is also true for most other models of secondary production; Kop Jansen and Raa (1990) have discussed this in details).

The coefficients matrix derived by the commodity technology model is given by:

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

Labour and capital inputs coefficients are also derived similarly, given by:

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

$k_j = K[VT]^{-1}$ = row vector of capital input coefficients by industry j. (j = 1,2,3,..., n)

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

$$\pi_j \equiv -(\Sigma_i p_i da_{ij} + dl_j + rdk_j)/p_j \quad (1)$$

Where: p_i = row vector of commodity prices in industry, i;
p_i = row vector of output prices in industry j:
r = average lending rate of the economy that is used as uniform price of capital input is assumed constant across industries (a scalar);
d = refers to differences.

Estimation of TFP Growth

The commodity technology model allows for TFP growth to be presented as the weighted sum of industrial or sectoral rates of TFP growth.

In addition, the following definitions are applied:
w = the annual wage rate (a scalar), assumed constant across industries; and,
n = total employment (a scalar) in the economy;
c = total capital stock (a scalar) in the economy;
p_t = row vector of prices at time t, showing the price per unit of output of each industry;
$y_t = p_t Y_t$ = gross national product at current prices at time t.

The usual growth accounting method measures the rate of aggregate TFP growth. The aggregate TFP growth can be defined as:

$$p \equiv [pdY - wdn - rdc/pY] \quad (2)$$

$$p \equiv [\Sigma_i \beta_i (dY_i) - \alpha_L (dn) - \alpha_K (dc)] \quad (3)$$

Where: $\alpha_L = wn/pY$, the wage share in total income; $\alpha_L = rc/pY$, the capital share in total income; and $\beta_L = p_j Y_j / pY$, showing the share of final output 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:

$$Y = (I - A)X \quad (4)$$

It follows that, $dY = (I - A)dX - (dA)X$ (5)

By definition, $dn = ldX + (dl)X$ (6)

$$dc = kdX + (dk)X \quad (7)$$

Substituting (5), (6) and (7) into (2) yields;

$$\rho = [p(I-A)dX - p(dA)X - wldx - w(dl)X - rkdX - r(dk)X]/pY \quad (8)$$

Making use of the basic Leontief price equation
$p(I-A) = wl + rk$ (9)

and, substituting (9) into (8), yields
$\rho \equiv -(pdA + wdl + rdk)X/pY$ (10)

Then, it follows from (1) and (10) that:
$\rho = \pi\hat{p}X/pY$ (11)

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

Moreover, from equation (3), $X = (I-A)^{-1}Y$ (12)

Substituting this into (10) 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: $\rho = \pi S\beta$ (13)

Where: π = sectoral rate of TFP growth;
$S = \hat{p}(I-A)^{-1}\hat{p}^{-1}$, the Leontief (value) inverse coefficient matrix, showing the value, in Malaysian Ringgit, of each input used per Malaysian Ringgit of output.
β = total final demand

DECOMPOSITION OF TFP GROWTH

The structure of linkage, final demand and technical change that are investigates in the present study are predicted to affect growth in TFP. As such, three hypotheses are developed for the present study. First, TFP growth estimates in the present study are expected to be positive. Second, all variables (structure of linkage, final demand and technical change) contribute positively to growth in TFP. As presented in Raa and Wolff (1991) and Wolff (1985, 1994), TFP growth can be decomposed into technical change;inter industry structure/linkage; and final demand effects.

$$d\rho = d\pi(S\beta) + \pi(dS)\beta + \pi S(d\beta) \quad (14)$$

Where:
$d\rho$ = change in aggregate TFP growth;
$d\pi$ = change in sectoral rates of TFP growth (contributions of technical change); $(d\beta)$ 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); $(\pi\beta)$ are assumed constant.

ESTIMATION OF PRICE AND REAL SHARE EFFECT

As indicated in equation (3), β_j is the value share of the final output of sector j in the total value of final output. Thus, a change in β_j reflects both changes in relative prices and changes in the share of real final output j in real total final output. The final demand effects can be decomposed into price and a real share effect (Wolff 1985). Relative prices are deflated using the GNP deflator:

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

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, $\delta_{it} = p_{i0}Y_{it}/p_0 Y_t = Y_{it}/p_0 Y_t$, where sectoral base year prices are set equal to unity. Then, $\beta_{it} = \sigma_{it}\delta_{it}$

And, $\Delta\beta \cong (\Delta\sigma)\delta = \sigma(\Delta\delta)$ (15)

SOURCES OF DATA AND INPUT-OUTPUT AGGREGATIONS OF SECTORAL

The present study utilises data from the 1983, 1987, 1991, 2000 and 2005 Malaysia's Input-Output Tables published by the Department of Statistics (DOS). Based upon the data, the present study examines four sub-periods: 1983-87; 1987-91; 91-2000; and 2000-2005. Labour and capital are unpublished data provided by the respective industries for the purposes of the IMS, which isalso compiled by the DOS. Labour inputs consist of employment; and total salary and wages. Capital stock is measured by the net fixed assets as of 31 December (gross fixed assets - depreciation rate + gross fixed capital formation/capital expenditure). Fixed assets, which represent capital inputs, consist of building and other structures; machinery equipment; transport equipment; and information communication technology tools, such as computers. As the data concerning profit rates are not available, the present study utilises the average lending rate to represent the price of capital input. Both labour and capital data are classified at the three digit-level of industrial aggregation according to the Malaysian Industrial Classification (MIC) and, consequently, must correspond with the Input-Output Industrial Classification.

The present study uses the producer price index (PPI) for local production by commodity group of the Standard International Trade Classification (SITC) to deflate some of the variables to reflect the real change in the variables. Deflators of PPI are derived from weighted price indices using a two digit-level of commodity group (SITC) and PPI for 'other sectors' of the domestic economy, the latter of which uses 1978 as its base year.

In terms of input-output sectoral aggregations, the existing framework of national income account classifications governs the potential maximum size of the Malaysian Input-Output Tables. However, the present study has reduced two sets of basic tables - 'make' and 'use' - into 32 by 32 industries/commodities. This covers all 31 industries of the manufacturing sector; and a 'single sector'.The 'single sector' represents the 'other sectors' and includes services; agriculture; mining and construction; and the remaining public sectors.

RESULTS AND DISCUSSION

Table 1 presents the weighted average annual rate of growth in TFP for the 31 sub-sectors of the manufacturing sector and the single sectors during the four sub-periods of 1983-87; 1987-91;91-2000; and 2000-2005. From the table, TFP growth estimates from the present study are 4.7%, 5.7%, 2.2% and 2.0% over four sub-periods of the study, respectively. Hypothesis I, which predicts that the TFP growth estimates will be positive during the four sub-periods examined in the present study, is supported by the results. However, the results obtained from the present study differ from the results in other studies (Okamoto1994; Maisom and Arshad 1992; Tham 1997 Noriyoshi et al. 2002). The finding is not surprising because the use of data from input-output table incorporates data from the IMS, which means that the data utilised in the present study differs from other studies that employ data from IMS *per se*. Moreover, different results for TFP estimation will be yielded by different methods; different procedures of data computation; and different aggregation of industrial sector (Tham 1996). Wong (1995) also reports that different studies on TFP growth in Singapore obtain different results in relation to TFP growth estimates.

Past studies reveal that TFP growth in the Malaysian manufacturing sector is quite low at 0.3% during period between 1986 and 1991 (Okamoto 1994; Tham 1997). However, Maisom and Arshad (1992) conclude that TFP growth is negative for each of the two digit industries covered in their examination of the period between 1973 and1989. Renuka (2001) obtains two results regarding TFP growth estimates for the period between 1986 and 1996: TFP growth in the manufacturing sector is consistently negative utilising the SFA, while the results are consistently positive when DEA is applied.

DECOMPOSITION OF TFP GROWTH

The main objective of the present study is to analyse the decomposition of TFP growth into three components, which correspond with the three terms on the right hand side of equation (16). The first of these is the 'sub-sectoral technical change effect' ($\Delta\pi$) which 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', which shows the change in overall TFP growth that occurs if technical change (π) and final output shares (final demand shares) (β) remained constant, but the inter-industry matrix S changed. The change in stems from changes in the Leontief inverse matrix. This term reflects, in part, changes in the linkage patterns among subsectors. The third is the 'output shares' or 'composition effect' ($\Delta\beta$), which shows how much overall TFP growth would change if sub-sectoral technical change and inter-industry structure remain constant over time, but the composition (value) of final output changes as it did in actuality. Moreover, it is also apparent that the three effects isolated in equation (14) are not independent. As shown in Table 2, the annual rate of aggregate TFP growth inclines from –16.8% to 13.3%, 23.6% and 50.1% per year during the period of 1983-87; 1987-91;91-2000; and 2000-05, respectively. The resulting changes in annual TFP growth between the four periods are 30.1%; 10.3%; and 26.5%, respectively.

Table 3 presents the decomposition results of the change in aggregate TFP growth. Since discrete time periods are used, the average value of β in the time period, $\bar{\beta}$, is used in place of β and the average values of matrix S in the period, $\bar{S}$, are used in place of S (see equation 14). The change in β between two sets of time periods are considered, leading to the three following examinations 1983-87/87-1991; 1987-91/91-2000; and 91-2000/2000-05.

As demonstrated in Table 3, the change in the TFP growth between the period of 1983-87 and 1987-91 inclines from –16.8% to 13.3% per annum, which

TABLE 1. Weighted Average Annual Rate of TFP Growth, 1983-2005 (%)

TFP growth	1983-1987	1987-1991	1991-2000	2000-2005
The manufacturing sector	4.7	5.7	2.2	2.0
The total economy	3.9	4.4	1.9	4.6

TABLE 2. Annual Rate of Aggregate TFP Growth

	Periods			
Annual rate (%)	1983-87	1987-91	91-2000	2000-05
	-16.8	13.3	23.6	50.1
Periods	Change in aggregate TFP Growth (%)			
1983-87/87-1991	30.1			
1987-91/91-2000	10.3			
1991-2000/2000-05	26.5			

TABLE 3. Decomposition of the Change in TFP Growth

Periods	Total	Percentage contribution: Technical change	Inter-industry structure	Output shares	Sum of three effects
1983-87/ 87-1991	1.504	11.3	-0.3	89.0	100.0
1987-91/ 91-2000	1.701	19.7	-1.0	81.3	100.0
1991-2000/ 2000-05	0.139	33.1	1.4	65.5	100.0

Source: Estimated from equation (14).
Note: Estimation of output shares is based on the final output demand.

indicates an increase by 150.4 percentage points. The first of the decompositions, as mentioned above, is the sub-sectoral TFP growth effect, which results from the change in the sub-sectoral rates of TFP; and accounts for 11.3% of the incline in aggregate TFP growth. The second is the inter-industry multiplier effect, which results from a change in matrix, ; and is small, accounting for –0.3% of the incline. The third is the final output effect, which accounts for 89.0% of the overall change in productivity. The result of inter industry structure/linkage did not support hypothesis II, which predicted that this variable would positively contribute to growth in TFP.

The change in the TFP between the periods of 1987-91and 91-2000 inclines from 13.3% to 23.6% per annum, or increases by 170.1 percentage points. The first component of the results indicates a technical change effect (sub-sectoralTFP growth effect) contributing to 19.7% of the incline in TFP growth. The second component remains the same and is small, accounting for -1.0% of the incline. As a result, the component of final output value shares remains large, contributing to 81.3% of the incline in overall TFP growth.

The period of 91-2000 and 2000-2005 indicates that the change in the TFP inclines from 23.6% to 50.1% per annum. The results also incline, but only by 13.9 percentage points. Technical change contributes 33.1% to the incline in TFP growth. The second component makes a positive contribution, accounting for 1.4% of the incline. However, the component of final output value shares declines, contributing 65.5% to the incline in overall TFP growth. The decline in the contribution of final demand is replaced by the incline in the contribution of technical change. During this period, the contribution of technical change to the incline in TFP growth improves substantially. Furthermore, the result is a good indication that the linkage component contributes positively to the change in overall TFP growth.

The result for the first two periods show the contribution of the component of final output is relatively larger, contributing more than 80.0% of the incline in total TFP growth, while the incline in TFP growth is more than 60% for the third period (Table 3). This reflects that the final output component is important in determining the overall change in TFP growth. The final output component is above 70.0% of total output (gross output) for 1983, 1987, 1991 and 2000 (Malaysian Input-Output Tables, various years). It should be noted that a major advantage of using final output in this study is the change in TFP growth, which 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 contrast, the change in gross output shares may be partly due to changes in the inter-industry matrix, which is considered an endogenous or derived effect. Therefore, based on this reason, Wolff (1994) suggests that a change in final output shares is methodologically closer to a 'pure' composition/final demand effect than the change in gross output shares.

The study of Raa and Wolff (1991) uses the results of United States I-O data to estimate TFP growth covering 85 sub-sectors for 1967, 1972 and 1977. The results of the study indicate that the largest contribution to the change in overall TFP growth is the technical change effect, accounting for 85.0% and 90.0% between the periods 1967-72 and 1972-77. Wolff (1985, 1994) determines that technical change effects contribute to 99.4% of the decline in TFP between 1958 and 1967; 99.8% to the decline in TFP between 1967 and 1976; and 97.7% of the decline in TFP between 1947 and 76. However, the studies performed by Wolff show a similar result in regards to the fact that the shares of final output were only 12.0%, 11.1% (Raa and Wolff 1991); and 5.2% and 5.4% (Wolff 1985); and 6.3% (Wolff 1994) for each period, respectively.

The results from the present study are different from the findings of Raa and Wolff (1991) and Wolff (1985, 1994). The latter studies find that technical change effects are the largest contributors to overall changes in TFP growth, while final output shares are relatively small. The inter-industry effect, however, indicates a negative contribution. In their studies, the value share effect was largely offset by the inter-industry effect. However, in the case of Malaysian, a rapid growth developing country, the contribution of technical change is very small. This reflects that the production structure of the Malaysian economy, in terms of technological progress, undergoes a small change in the range of 10.0% to 20.0%, between 1983 and 2000. However, technological progress increases remarkably during the period of 2000 to 2005. From this evidence, the argument can be made that certain industries in the manufacturing sector are making little progress in relation to technological change. This finding is supported by Rahmah et al. (2006), who find that local industries are less competent due to issues, such as financial problems; the low-level of technology used; the lack of skilled workers; and entrepreneurship. A low rate of progress in relation to technological change will hamper the creation of higher value-added products and services,in which value added products are usually related to the use of new technology.

Remarkably, the contribution of final output shares to the change in overall TFP is significant. This may imply that the final demand component determines the contribution to the change in overall TFP growth. The component of final demand consists of domestic demand and exports, which are essential as foreign direct investment functioning on the production of the export goods. In addition, the growth of the domestic economy is supported by a dynamic domestic demand (Bank Negara 2007). Other studies similarly conclude that most of the sources of growth for the key sectors between 1978 and 1991 stem from final demand, especially domestic demand expansion. In addition, several key sectors are dominated by export demand expansion during this period, such as vegetable, fruits, sawmills and furniture and fixtures (Rohana et al. 2008). Zakariah and Ahmad (1999) also reach the same conclusion, indicating that domestic-demand expansion is the dominant source of growth in the Malaysian economy during the sub-period of 1978 to 83, while exports expansion is dominant in light and heavy industries during the same period. Other studies also reveal that the main factors contributing positively to the growth in TFP are the rate of change in output; the rate of change in exports; and foreign investment characteristics (Tham 1996, 1997).

In terms of linkage effects, the present study reveals that linkage patterns among industries are negative during the first two periods of the study. This implies that linkages or inter-industry structure may not contribute to the growth in TFP. This may be due to the characteristics of multi-national companies, who usually bring their subsidiary companies into the host country for the purpose of supplying parts and components to the leading companies. Studies by Rasiah (1988) and Anuwar (1992) determine that the integration between the indigenous ancillary or local supportive industries and the multinational companies is weak in Malaysia. This implies that linkages between industries may only occur among the local firms, while linkages between local and foreign firms might not exist in general. For instance, the characteristics of multinational companies in Singapore that are engaged in processing industries, which import unfinished components 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 final demand effects can further be decomposed into real share effects and price effects. As mentioned above, the value share of the final output of sector in the total value of final output, indicated by , can reflect relative price change and real shares change. The price effects show how much overall TFP growth would have changed if the prices changed but the real final output shares had remained constant. This effect indicates that out of the 89.0% change in output, accounting for only 4.6% of the price change between 1983-87 and 1987-1991. During the second period of 1987-97 and 91-2000, there is an increasing trend in price effects, but it is relatively small, accounting for only 12.6% of the price change. The change in prices, however, increases by 87.6% out of 65.5% of the final output shares during the period of 91-2000 and 2000-05, most probably due to the uncertainty of the global economic situation.

The real share effects show how much overall TFP growth would change if real final output shares shift (between 1983-87 and 1987-91; 1987-91 and 91-2000, and,91-2000 and 2000-05), but the relative prices of 1983-87 had remained unchanged. In Table 4, the real share effects during the three periods accounts for about 84.4%,68.7%, and –22.1% of the change in overall TFP growth, respectively. The primary reason for this is that changes in real final output shares for the three periods are uncorrelated with sectoral productivity growth because the final output is an 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 an increase in relative price will increase production by producers due to the larger final demand of exports and domestic demand expansion.

TABLE 4. 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	1.504	0.070 (4.6)	1.269 (84.4)	1.339 (89.0)
1987-91/ 91-2000	1.701	0.215 (12.6)	1.169 (68.7)	1.384 (81.3)
91-2000/ 2000-05	0.139	0.122 (87.6)	–0.031 (–22.1)	0.091 (65.5)

Source: Estimated from equation (15).

CONCLUSION AND POLICY IMPLICATIONS

The present study concludes that the exogenous influence of the economy's final demand, which is comprised of export and domestic demand, is the principal contributor to the overall TFP growth in Malaysia. On the other hand, technical change and linkage, which are endogenous factors, play relatively minor roles. These factors contributed a small fraction to the overall TFP growth in Malaysia, with linkage contributing negatively to TFP growth during the first two periods.The results concerning final demand actually indicate that the Malaysian economy is dependent on the output growth of the manufacturing sector, meaning that the output growth of the manufacturing sector is actually reliant upon exports and domestic demand.The finding indicates that both export and domestic demand are essential for the growth of the manufacturing sector and the Malaysian economy, while technical change and linkage makes a small contribution to the growth of TFP.

Based on the past performances of the Malaysian economy, the manufacturing sector can potentially achieve a higher rate of growth by increasing output,which can be accomplished by thediversificationof exports and managing domestic demand. This can be accomplished through a combination of monetary and fiscal policy measures. Under the various plans of the economic development program, many incentives have been given to manufacturers in the form of monetary incentives and fiscal incentives, such as taxes and subsidies. Although the economy is known to be a small open developing economy, it has significant control on the economy in determining its overall TFP growth by managing export and domestic demand. From a policy viewpoint, the economy's relative size and structure of private consumption expenditure can be used to influence its overall TFP growth.

The indirect contribution of final output demand to growth in TFP, however, is related strongly to the contributions of FDI. As Malaysian industrial strategies invite foreign investment through various incentives, especially through the promotion of exported manufactured products, the manufacturing sector leads GDP 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 actively pursued. This can be accomplished through the 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 difficulties, there are limited measures to rectify the situation except in the long run by diversifying the export destinations.

Captured by the contribution of linkages, the contribution of technical change to overall TFP growth is still very limited. This may be due to the fact that most leading firms are actually multinational companies of FDI. Thus, it is no surprise that these leading firms have no linkage with local firms. It is also interesting to note that the total export share of multinational firms in the Malaysian economy is more than 70.0% (Bank Negara, 2006). Noorasiah et al. (2012) find that non-resource based industries are relatively efficient in using domestic and imported intermediate inputs compared to resource based industries during the period between 1983 and 2005. The study also shows that resource based industries are actually sourced by domestic inputs; while non-resource based industries rely on imported input, as well as FDI, in concentrated non-resource based industries in Malaysia. The fact that most FDI is concentrated in non-resource-based industries is one of the major problems in the development of the manufacturing sector. The problem arises from the rather weak link forged between the manufacturing sector and the domestic economy. The other major problem lies in the existence of a relatively narrow industrial base where the export of manufactured goods is concentrated in the electrical and electronics; and textile sectors.

The over dependence on imported raw materials is normally a characteristic of multinational companies operating in the host countries, whereby such companies engage in processing industries which import unfinished components and export finished products (Tsao 1985). The situation results in weak linkages between indigenous industries and foreign companies, In contrast, linkages within the multinationals' network of plants located throughout the world tend to be stronger. However, enhancing inter-industry structure and 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. Definitely, the country's industrial policy review should focus more upon strengthening inter-industrial linkages, especially among the non-resource based industries, to improve linkages between multinational corporations and their local vendors. Finally, yet importantly, the empirical results demonstrate that changes in real share effects are more significant than changes in price effects and support the findings concerning the importance of the role of final demand in affecting TFP growth.

REFERENCES

Anuwar, A. 1992. Globalization and technology transfer: Issues in the Asia Pacific region, paper presented at National Conference on Economic Globalization: Issues, Challenges and Responses, Langkawi, Malaysia. 15-16 August.

Bank Negara. 2007. *Annual Report 2006*. Kuala Lumpur: Bank Negara Malaysia.

Bank Negara. various years. *Annual Report*. Kuala Lumpur: Bank Negara Malaysia.

Department of Statistics. various years. *Malaysia Input-Output Tables*. Putrajaya: Department of Statistics.

Department of Statistics. various years. *Industrial Manufacturing Survey*: *Unpublished Data*. Putrajaya: Department of Statistics.

Department of Statistics. 2006. *Malaysia Economic-Statistics Time Series* 2005. Putrajaya: Department of Statistics.

Department of Statistics. various years. *Labour Force Survey*. Putrajaya: Department of Statistics.

Malaysia Economic Reports. various years. *Annual Report*. Kuala Lumpur: National Printing Department.

Fatimah Said & Saad Mohd Said. 2004. Total factor productivity growth in Malaysian manufacturing sector: Emphasis on heavy industries. *International Journal of Economics and Management* 12(2):131-164.

Idris Jajri. 2007. Determinants of total factor productivity growth in Malaysia. *Journal of Economic Cooperation* 28(3):41-58.

Kop Jansen, P. & Raa, T. T. 1990. The choice of model in the construction of input-output coefficients matrices. *International Economic Review* 31(1): 213-227.

Maisom Arshad & Arshad Marshidi. 1992. Pattern of total factor productivity growth in Malaysia manufacturing industries, 1973-1989, Paper presented at HIID-ISIS Seminar, Kuala Lumpur.

Maisom Arshad, Mohd Ariff, H. & Nor Aini, M. A. 1993. Productivity and efficiency in Malaysian manufacturing sector: A time series analysis. In *Proceeding of the First Malaysian Econometric Conference,* edited by Semundram, M. & Yap, M. Kuala Lumpur: Malaysian Institute of Economic Research (MIER).

Malaysian Productivity Corporation (2006). *The Productivity Report 2005*. Petaling Jaya: Malaysian Productivity Corporation.

Menon, J. 1998. Total factor productivity growth in foreign and domestic firms in Malaysian manufacturing. *Journal of Asian Economics* 9(2): 251-280.

Nik Hashim Nik Mustapha. 1998. Output versus productivity growth in the manufacturing industry: An experience for sustainable development planning. Faculty of Economics Workshop, The National University of Malaysia, Port Dickson, 19-21 June.

Nishimizu, M. & Robinson, S. 1984. Trade policies and productivity change in semi-industrialized countries. *Journal of Development Economics* 16(1-2): 177-206.

Noorasiah Sulaiman, Zakariah Abdul Rashid & Khalid Abdul Hamid. 2012. Productivity improvement in the utilization of domestic and imported inputs in resource and non resource-based industries: 1983-2005. *International Journal of Management Studies* 19(1): 87-114.

Noriyoshi, O., Nor Aini, M. A., Zainon, B., Rauzah, Z. A. & Mazlina, S. 2002. Productivity of foreign and domestic firms in the Malaysian manufacturing industry. *Asian Economic Journal* 16(3): 215-228.

Okamoto, Y. 1994. Impact of trade and FDI liberalization policies on the Malaysian economy. *The Developing Economies* 32(4): 460-478.

Rahmah Ismail. 1999. Contribution of input quality to labour productivity in the SMIs in Malaysia, Department of Statistic Economics Workshop, Faculty of Economics, The National University of Malaysia, Port Dickson.

Rahmah Ismail, Nor Aini Idris, Mohd Nasir Mohd Saukani & Noorasiah Sulaiman. 2006. *Daya Saing Usahawan dan Syarikat Melayu dalam Sektor Pembuatan dan Perkhidmatan*. Kuala Lumpur: DBP.

Rasiah, R. 1988. The semi-conductor industry in Penang: Implications for the new international division of labour theories. *Journal of Contemporary Asia* 18(1): 44-67.

Renuka, M. 2001. Assessing the output and productivity growth of Malaysia's manufacturing sector. *Journal of Asian Economics* 12(4), 587-597.

_____________. 2002. Is there a real TFP growth measure for Malaysia's manufacturing industries? *ASEAN Economic Bulletin* 19(2): 178-190.

Rohana Kamarudin, Zakariah Abdul Rashid & Kamaruzaman, J. 2008. An input-output analysis of sources of growth and key sector in Malaysia. *Modern Applied Science* 2(3): 94-108.

Raa, T. T., Debesh, C. & Small J. A. 1984. An alternative treatment of secondary products in input output analysis. *Review of Economics and Statistics* 66(1): 88-97.

Raa, T. T. & Wolff, E. N. 1991. Secondary products and the measurement of productivity growth. *Regional Science and Urban Economics* 21(4): 581-615.

Raa, T. T. & Kop Jansen, P. 2004. The choice of model in the construction of input-output coefficients matrices. In *Structural Economics*, edited by Raa, T. T., 41-57. London: Routledge, London.

Tham, S. Y. & Choong, P. Y. 1995. Total factor productivity in the Malaysian manufacturing sector: Some preliminary results. *Jurnal Ekonomi Malaysia* 29: 9-35.

Tham, S. Y. 1996. Productivity, growth and development in Malaysia. *The Singapore Economic Review* 40(1): 41-63.

_____________. 1997. Determinants of productivity growth in the Malaysian manufacturing sector. *ASEAN Economic Bulletin* 13(3): 333-343.

Tsao, Y. 1985. Growth without productivity: Singaporean manufacturing the 1970s. *Journal of Development Economics* 19(1-2): 25-38.

Viet, V. Q. 1986. *Study of Input-Output Tables 1970-1980*. Geneva: United Nation Statistical Office.

Wolff, E. N. 1985. Industrial composition, inter-industry effects and the U.S productivity slowdown. *Review of Economics and Statistics* 67(2): 268-277.

_____________. 1994. Productivity measurement within an input-output framework. *Regional Science and Urban Economics* 24(1): 75-92.

Wong, F. C. 1995. Productivity and growth, discussion. In *Proceedings of a Conference Economic*, edited by Andersen, P., Dwyer, J. & Gruen, D. Australia: Group Reserve Bank of Australia, Ambassador Press Pty Ltd., Australia.

Zakariah A. R. & Ahmad E. A. 1999. Sources of industrial growth using the factor decomposition approach: Malaysia, 1978-1987. *The Developing Economies* 37(2):162-196.

Noorasiah Sulaiman
School of Economics
Faculty of Economics and Management
Universiti Kebangsaan Malaysia
43600 UKM Bangi Selangor
MALAYSIA
rasiahs@ukm.my

Zakariah Abdul Rashid
Malaysian Institute of Economic Research (MIER)
Level 2, Podium City Point, Kompleks Dayabumi
Jln. Sultan Hishamuddin
50050 Kuala Lumpur
MALAYSIA
zakariah@mier.po.my