The Effects Of Human Capital
On Malaysia's Maunfacturing
Productivity Growth

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ABSTRACT

The objective of this paper is to examine the effects of human capital on the productivity growth in Malaysia's manufacturing sector. To achieve this, labour input was subdivided into skilled semi-skilled and unskilled. The study found that materials account for the largest cost component in the sector although shortages of skilled labour constitute a serious constraint on capital utilisation. In addition, the contribution of total factor productivity (TFP) growth of the sector was generally found to be very low particularly during the second sub-period of 1987-2001. The improvement and slowdown of TFP contribution to manufacturing sector in terms of average annual growth rates were dependent on the inputs used in production, believed to be of low quality and insufficient.

INTRODUCTION

$\mathcal{T}$he structure of the Malaysian economy has achieved a remarkable change since gaining independence in 1957. That is moving from a simple agricultural economy to a heavy industrial economy. However, the agricultural sector share in the GDP dropped from 29 percent in 1970 to 13 percent in 1996, further to 8 percent in 2000. It rose to 8.7 percent in 2001 and to 8.4 percent in 2002. On the other hand, the share of the manufacturing sector in GDP increased from 14 percent in 1970 to 35 percent in 1996, 33 percent in 2000, 30.2 percent in 2001, and 30.4 percent in 2002 (Economic Report various issues). Consequently, a commendable structural change in employment was witnessed when agricultural employment dropped from 53 percent in 1970 to 16 percent in 1996, but rose to 18 percent in 2000, although it declined again to 14.7 percent in 2001 and further to 14.2 percent in 2002. All other sectors of the economy have experienced impressive increases in their shares of employment mainly the manufacturing industry, whose share increased from 8.7 percent in 1970 to 30 percent in 1996. It further rose to 31 percent in 2000 and decreased to 26.7 percent in 2001 and increased to 27.2 percent in 2002. Moreover, another important structural change has been achieved in the export composition, where the manufacturing share increased sharply from 12 percent in 1970 to 82 percent in 1996, 86.6 percent in 2000, and 86.1 percent in 2001 and to 86.2 percent in 2002. The share of the major agricultural product exports decreased from 55 percent in 1970 to 9 percent in 1996 and further 4 percent in 2000 and increased to 4.8 percent in 2001 and to 5.7 percent in 2002 (Economic Report various issues).

It is evident that Malaysian manufacturing industry depends heavily on foreign direct investment (FDI). The economic growth which is driven by inputs and mainly new investments and capital accumulation is inevitably subject to diminishing returns to scale and may not be sustainable in the long run (Kim and Lau 1994). Hence, the government is now pursuing the economic growth through productivity improvement and productivity driven strategies that emphasise enhancing total factor productivity (TFP)) growth rather than investment driven growth. The transition from a production-based economy (P-economy) to a knowledge-based economy (K-economy) implies that manufacturing industry will face a new set of challenges. Meeting these challenges depends on the ability to diffuse knowledge in the best possible ways. One of the main points in these challenges is to focus on achieving high technology levels that accompany human resources development through knowledge or the so-called knowledge workers and ICT.

Total Factor Productivity And Knowledge

It has been documented in empirical work on economic growth that after accounting for physical and human capital accumulation, "something else" accounts for the bulk of output growth in most countries. Both physical and human capital accumulations are certainly critical for economic growth. The process becomes more complicated with the role of knowledge in the economic growth process. Knowledge accounts obviously for a part of the growth that is not accounted for by the other factors of production, namely capital and labour. In growth theory, the so-called Solow residual is an unexplained residual of labour and capital it is attributable to the growth of Total Factor Productivity (TFP). The notion of TFP is interpreted as an "index of all those factors other than labour and capital not explicitly accounted for but which contribute to the generation of output." TFP refers to the additional output generated through enhancements in the efficiency accounted for by such things as advancement in human capital, skills and expertise, acquisition of efficient management techniques and know-how, improvements in an organisation, gains from specialisation, introduction of new technology, innovation or upgrading of present technology and enhancement in Information and Communication Technology (ICT). TFP can explain the growth in a K-based economy because it captures endogenous technical change and other characteristics of the K-based economy, including diffusion of knowledge, organisation, restructuring, networking, and new business models that would contribute to market efficiency and productivity. While intellectual capital can be gauged to some extent, and incorporated into capital, there are many factors that explain growth in the K-based economy that are not measurable at present. The size and performance of the TFP provide a clue to the extent of the performance of the K-based economy. When growth accounts fail to consider improvements in the quality of labour inputs due to education, these improvements would be assigned to TFP. Unmeasured improvements in the stock of physical capital would also be assigned to TFP (Knowledge-Based Economy Master Plan, 2002).

Malaysia's Experience In Knowledge-Based Economy

There is no one standard definition of the knowledge-based economy but an acceptable one must place importance on the generation and exploitation of knowledge to create new value in the economy. Indeed, knowledge is information that is put to productive work. Knowledge includes information in any form, know-how and know-why. Knowledge is not only embodied in goods and services, particularly in high technology industries, but also in knowledge as a commodity itself, manifested in forms such as intellectual property rights or in the tacit knowledge of highly mobile key employees. And it involves the way people interact as individuals and as a community. Unlike capital and labour, knowledge is a public good and sharing with others involves zero marginal cost. In addition, technology breakthrough based on knowledge creates technical platforms that support further innovations and drive economic growth (Bank Negara, 1999). The Knowledge-based economy is not confined to information technology (IT). Before the advent and proliferation of IT, it was knowledge that was embodied in human beings "human capital" and technology that was embodied in the capital investment undertaken by the Asian economies that brought about the so called Asian miracle. These two types of investments had helped to close the "knowledge gap" between the developed and emerging countries on how to transform inputs into desired outputs. With IT developments, the management of this knowledge gap has become more complex as the globalisation process gains momentum (Bank Negara, 1999).

Meanwhile, according to Han, 2003, to date, the contributions to the development of the Malaysian Knowledge-based economy have come largely from government policy makers, management consultants, and businesspersons. There are some academic researchers working on various aspects of information and communications technology (ICT), developments in the country, in particular the progress of the Multimedia Super Corridor (MSC) and a number of National IT Agenda. A major effort is the book Malaysia and K-economy (2001) by a number of academicians of the Malaysian Multimedia University. Also, a number of local studies on some aspects of ICT developments and related innovative practice are also reported in the Proceedings of the Asia Pacific Economics and Business Conference 2002 (UPM). In addition, Elsadig (2003) work tried to complete other knowledge-based economy work on Malaysian manufacturing sector using secondary data. It also examines the role of manufacturing sector productivity growth in achieving knowledge-based economy through information technology. In order to close the gap, the current paper uses knowledge workers instead of IT that was used in the pervious paper due to the fact that the Knowledge-based economy is not confined to information technology (IT). As mentioned

earlier, these two types of investments had helped to close the "knowledge gap" between the developed and emerging countries on how to transform inputs into desired outputs, and to see how much the difference between using knowledge workers and information technology in achieving knowledge-based economy through total factor productivity growth contributes to Malaysia's manufacturing sector productivity growth.

In addition, this study attempts also to close the gap of the divisia translog index approach that was developed by Jorgenson et al (1987). This approach does explicit specification of a production function that created major drawback in the pervious studies in the Malaysian manufacturing sector productivity growth. Those approaches were not based on statistical theory and, hence statistical models can not be applied to evaluate their reliability, thus casting doubts on their results. This study suggests closing this gap by providing a statistical analysis in the first step of the estimation and in the second step plugging the parameters of the variables into the model of the above mentioned divisia translog index approach to calculate the growth rates of productivity indicators including the calculation of the residual of the model (TFP), and output growth. Moreover, the major objective of this paper is to estimate the knowledge-based economy achievement through the contribution of skilled labour and TFP of the Malaysian manufacturing sector.

METHODOLOGY AND ESTIMATION PROCEDURES

The present study attempts to apply the conventional growth accounting framework as utilised by Stigler (1947), Albramovitz (1956), Kendrick (1956), Solow (1956, 1957), and finally brought to fruition by Kendrick (1961) BUT further refined by Denison (1962, 1979), Griliches and Jorgenson (1962), and Jorgenson et. al. (1987). The production of each industry is expressed as a function of capital, labour, raw materials, and time. It is assumed that the production process is characterised by constant returns to scale for each industry so that the proportional increase in all inputs results in a proportional change in industrial output. This approach provides more room for decomposition of contributions of factor inputs and technological change to economic growth.

The production function for i*th* industry can be represented as follows:

$$Qi = Fi\,(Ki, Li, Mi, T) \tag{1}$$

where output Qi is a function of sectoral capital input Ki, labour input Li, intermediate input Mi, and time T, that proxies for total factor productivity as a technological progress of the of the manufacturing sector.

Attempt is to apply the above-mentioned conventional growth accounting framework under assumptions of competitive equilibrium (where factors of production are paid the value of their respective marginal products) and constant returns to scale. The Divisia Index basically decomposes the output growth into the contribution of changes in inputs such as capital, materials input, labour (labour is split into three categories such as skilled, semi skilled, and unskilled), and total factor productivity (TFP) growth. In other words, considering the data at any two discrete points of time, say T and T-1, the growth rate of output Q for an industry can be expressed as a weighted average of the growth rates of capital (K), intermediate inputs (M) labour (skilled SL, semi skilled ML and unskilled UL), plus the residual of their (TFP). Hence the TFP growth of each industry i is computed as the difference between the rate of growth of output and weighted average of the growth in the capital, intermediate inputs, and labour, where the weights are the respective shares of each input in the industry's gross output. It follows that

$$
\begin{aligned}
\overline{W}^{\,i}_{\,T} \;=\; & [\ln Qi(T) - \ln Qi\,(T-1)] - \overline{W}^{\,i}_{\,K}\;[\ln Ki(T) - \ln Ki\,(T-1)] \\
& - \overline{W}^{\,i}_{\,M}\;[\ln Mi(T) - \ln Mi\,(T-1)] - \overline{W}^{\,i}_{\,SL}\;[\ln SLi\,(T) - \ln SLi\,(T-1)] \\
& - \overline{W}^{\,i}_{\,mL}\;[\ln MLi(T) - \ln MLi\,(T-1)] - \overline{W}^{\,i}_{\,uL}\;[\ln ULi\,(T) - \ln ULi\,(T-1)] \\
& \quad i = 1 \quad \text{and } T = 1970 - 2001
\end{aligned}
\tag{2}
$$

where the weights are given by the average value shares

$$\overline{W}^{i}_{K} = 1/2\,[(WiK\,(T) \;+\; WiK\,(T\text{-}1)],$$

$$\overline{W}^{i}_{M} = 1/2\,[(WiM\,(T) \;+\; WiM\,(T\text{-}1)],$$

$$\overline{W}^{i}_{sL} = 1/2\,[(WiSL\,(T) \;+\; WiSL\,(T\text{-}1)],$$

$$\overline{W}^{i}_{mL} = 1/2\,[(WiML\,(T) \;+\; WiML\,(T\text{-}1)],$$

$$\overline{W}^{i}_{uL} = 1/2\,[(WiUL\,(T) \;+\; WiUL\,(T\text{-}1)],\text{and}$$

$$\overline{W}^{i}_{T} = 1/2\,[\,(WiT(T) \;+\; WiT\,(T\text{-}1)]$$

According to Tham (1997), $\overline{W}^{i}_{K}$, $\overline{W}^{i}_{M}$, $\overline{W}^{i}_{SL}$, $\overline{W}^{i}_{ML}$ and $\overline{W}^{i}_{UL}$ denoted the shares of capital, material, skilled labour, semi skilled, and unskilled labour, i is number of industries and T time of manufacturing sector and bar indicates a simple average over two successive time-periods, (T) and (T-1), and the average productivity growth term, $\overline{W}^{i}_{T}$, is the translog index of TFP growth.

According to Mahadevan, 2001, the TFP growth studies on the Malaysian manufacturing sector have used the nonparametric translog-divisia index approach developed by Jorgenson et al. (1987). This approach does not require the explicit specification of a production function, but the major drawback is that it is not based on statistical theory and, hence, statistical methods cannot be applied to evaluate their reliability, thus casting doubts on their results. The present study attempts to close this gap by developing this model into parametric model and providing statistical analysis for it in the first step as follows: -

$$\ln Q_{T} = a + \alpha.\ln K_{T} + \beta.\ln M_{T} + \lambda.\ln sL_{T} + \theta.\ln mL + \sigma.\ln uL_{T} +_{T} \varepsilon_{T}$$
$$_{T} = 1970\text{-}2001$$

(3)

where

α is the output elasticity with respect to capital
β is the output elasticity with respect to material
λ is the output elasticity with respect to skilled labour
θ is the output elasticity with respect to semi skilled labour
σ is the output elasticity with respect to semi skilled labour
a   is the intercept or constant of the model[1]
ε_{T} is the residual term[2]
ln   is the log to reduce the problem of heteroskedasticity.

Since the intercept (a) has no position in the calculation of the productivity growth rate indicators, a second step is proposed, which calculates the growth rates of productivity indicators transforming equation [2] as

$$\Delta \ln TFP_{T} = \Delta \ln Q_{T} - [\,\alpha.\Delta \ln K_{T} + \beta.\Delta \ln M_{T} + \lambda.\Delta \ln sL_{T}$$
$$+ \theta.\Delta \ln mL_{T} + \sigma.\Delta \ln uL_{T}\,]$$

(4)

where the weights are given by the average value shares as follows:

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[1] The intercept term, as usual, gives the mean or average effect on dependent variable of all the variables excluded from the model.
[2] The residual term proxies for the total factor productivity growth that accounting for the technological progress of the manufacturing sector through the quality of input terms.

$\Delta \ln Q_T$ is the growth rate of output

$\alpha . \Delta \ln K_T$ is the growth rate of the capital

$\beta . \Delta \ln M_T$ is the growth rate of the material

$\lambda . \Delta \ln s L_T$ is the growth rate of the skilled labour

$\theta . \Delta \ln m L_T$ is the growth rate of the semi skilled labour

$\sigma . \Delta \ln u L_T$ is the growth rate of the unskilled labour

$\Delta \ln TFP_T$ is the total factor productivity growth

Δ is the difference operator denoting proptionate change rate.

The framework decomposes growth rate of output into the contributions of the rates of growth of the capital material inputs, skilled, semi and unskilled labour plus a residual term typically referred to as the rate of growth of TFP.

RESULTS AND DISCUSSIONS

Autoregressive estimator is applied to the model generated from a production function to measure the shift in the production functions of Malaysia's manufacturing sector. An annual time series data over the period of 1970-2001 for gross value of output; number of employment which is split into three categories skilled, semi skilled, and unskilled labour, value of fixed assets, and cost of input (obtained from the Department of Statistics) were employed. Except for the number of employment the data were deflated by producer price index (1980=100) to obtain the real value of variables from its nominal data. The model, which was attributed to Jorgenson et al, (1987), expressed the decomposition of growth value of output into contribution of changes in capital, material inputs, skilled, semi skilled and unskilled labour, and TFP growth. Analysis of the data showed that estimated coefficients of material inputs and unskilled labour of manufacturing sector were significant at 5% level and that of capital, and semi skilled labour were significant at 10% level. By Durbin-Watson value the model was found not to be consistent without autocorrelation problem (Tables 1).

Table 1: Output Elasticity Of Malaysian Manufacturing Sector Productivity Indicators 1970-2001

Intercept	1.80 (2.05)**
Capital	0.04 (1.74)*
Material	1.02 (7.98)**
Skilled Labour	-0.41 (-1.50)
Semi Skilled Labour	0.01364 (1.83)*
Unskilled Labour	0.23 (1.96)**
Adjusted R^2	0.99
Durbin-Watson	1.92

Notes: Figures in Table 3 were estimated using equation (3). Figures in parenthesis are T-values. **Indicate significant at 5% level. *Indicates significant at 10% level.

Empirical Analysis

Analysis was carried out to compare the productivity indicators within the manufacturing sector for the entire period of 1970-2001. In order to study the effect of government policies to improve the sector's productivity growth as well as to study the impact of knowledge workers on Malaysian manufacturing sector in achieving the knowledge-based economy status, the study period was split into two phases. These phases, which correspond with the major policy changes, are 1971-1986 and 1987-2001. The period of the 1970s witnessed the birth of Malaysia's era of export-oriented economy. The policy shifted from import substitution to labour intensive and export oriented industries with electronics and textiles as the main areas of emphasis and growth. The decade of 1980s saw a further diversification of the economy into more advanced industries. The Heavy Industries Corporation of Malaysia (HICOM) was conceived in 1980. As a result of these polices the range of economic activities and sources of growth had become more diversified. The period of 1987-2001 witnessed further diversification of the economy into more advanced industries. During this period the economic structural transformation took place in the Malaysian economy, and the manufacturing sector became the engine of growth. In this period, policy makers developed the first and second Industrial Master Plans and gave priority to twelve industries to contribute more to Malaysia's industrial development.

The model expresses the decomposition of growth value of output into contribution of changes in capital, material inputs, and labour in its three categories skilled, semi skilled and unskilled, and TFP. The use of TFP overcomes the problems of single productivity indicators such as labour productivity and capital deepening by measuring the relationship between output and its total inputs (a weighted sum of all inputs), thereby giving the residual output changes not accounted by total factor input changes. Being a residual, changes in TFP are not influenced by changes in the various factors which affect technological progress such as the quality of factors of production, flexibility of resource use, capacity utilisation, quality of management, economies of scale, and the like (Rao and Preston, 1984). The improvement and slowdown of TFP contribution to manufacturing sector industries in terms of average annual growth rates are dependent on the inputs used in the production of manufacturing sector industries, that were reported to be of low quality and insufficient. However, the contribution of TFP growth to the manufacturing sector average annual productivity growth was 0.19, 0.34 and 0.02 percent during the entire period of the study and two sub periods of the study respectively (Table 2).

Meanwhile, the contribution of gross value of output to the manufacturing sector average annual productivity growth was positive during the entire period of 1970-2001 and sub-periods of 1971-1986 and 1987-2001, that is, their contributions were 12.7, 11.2 and 14.3 percent, respectively. The highest contribution of gross value of output to the productivity growth of manufacturing sector was the contribution of the sub-period of 1987-2001 at 14.3 percent. This was the period where structural transformation took place in the Malaysian economy in 1987, in which the manufacturing sector became the engine of growth of the Malaysian economy instead of the agricultural sector, which was the engine of growth since independence in 1957 until 1986. The lowest contribution of gross value of output to the productivity growth of manufacturing sector was in the sub-period of 1971-1986 at 11.2 percent. This was the period of economic crisis, in which the performance of the manufacturing sector was very low compared to the previous period after the transformation of the Malaysian economy into an export-oriented one.

Moreover, the contribution of capital input to the output of manufacturing sector average annual productivity growth was positive during the entire period of 1970-2001, sub-periods of 1971-1986, and 1987-2001, in which their contributions were 13.6, 14.8 and 12.4 percent, respectively (Table 2). The contribution of materials (as the cost of inputs) to output average annual productivity growth of manufacturing sector was positive too during the entire period of 1970-2001 and sub-periods of 1971-1986, and 1987-2001 which were 12.98, 11.3 and 14.6 percent respectively (Table 2). The highest contribution of materials to output average annual productivity growth of manufacturing sector was during the sub-period of 1987-2001, which was 0.14662. In fact, during this period the manufacturing sector had consumed a huge amount of raw materials and other inputs either locally or imported. This was one of the factors that attracted the Foreign Direct Investment (FDI) to Malaysia and other Asian countries, besides the cheap cost of labour.

Finally, the contribution of labour (as number of employment in its three categories) to output average annual productivity growth of the manufacturing sector for skilled labour was positive during the entire period of 1970-2001

and sub-periods of 1971-1986, and 1987-2001 estimated at 4.787, 2.908 and 6.79 percent respectively (Table 2). And that for the semi skilled labour was 9.270, 8.60 and 10.5 percent respectively. While that of the unskilled labour were 4.73, 2.80 and 7.55 percent respectively. The highest contribution of labour to the output average annual productivity growth of the manufacturing sector of the three categories was during the sub-period of 1987-2001. During this period there was a very wide movement of workers from the agricultural sector to the manufacturing sector. Many people migrated from rural areas to urban areas to join the workforce in the manufacturing sector. They improved their living standards and became urbanised as they gained new skills as well. The lowest contribution of labour to output average annual productivity growth of the manufacturing sector was during the sub-period of 1971-1986. During this period many workers were still employed in the agricultural sector, by the opportunities available to them in their hometowns and agricultural plantation areas in the country. That was due to the fact of agricultural sector was the engine of Malaysia's economic growth during this period before replacing it by the manufacturing sector in 1987.

It should be recalled here that these results prove that the productivity growth of Malaysia's manufacturing is input driven rather than productivity growth driven when the results of TFP were compared with that of gross value of output for the two sub-periods of 1971-1986 and 1987-2001. It was also found that there was declining contribution of the TFP during the sub-period of 1987-2001, although the contribution of gross value of output was the highest one during this sub-period and vice versa during the sub-periods of 1971-1986. This supports the assumption that the Malaysian productivity in general and that of manufacturing sector in particular is input driven rather than TFP driven. It was also confirmed by Lall (1995), as in other Asian newly industrialised countries IN which their productivity is input driven as stated by Young (1992, 1995), and Kim and Lau (1994). Sarel (1996) also expressed his concerns that some East Asian countries may face the same fate of the Soviet Union. This is because these countries invested primarily in labour and capital rather than in technology over the past few decades.

By examining the three categories of labour it was found that the contribution of semi skilled labour was more than skilled and unskilled labour in all the periods studied, and the contribution of unskilled labour was more than skilled labour during the sub period of 1987-2001, this was the period of structural transformation. For the Malaysian economy to reach the knowledge-based economy through the productivity of manufacturing sector, the contribution of the skilled labour should be more than the contributions of the other two categories of labour – semi skilled and unskilled labour. In addition, the TFP growth was lower in all the periods of the study and its contribution was very low during the sub period of 1987-2001.

Table 2: Productivity Indicators Of The Malaysian Manufacturing Sector

Productivity Indicators	1971-2001	1971-1986	1987-2001
Total Factor Productivity	0.19	0.34	0.02
Gross Value of Output	12.7	11.2	14.3
Capital	13.6	14.8	12.4
Material	13.0	11.3	14.6
Skilled Labour	4.79	2.91	6.79
Semi Skilled Labour	9.27	8.60	10.5
Unskilled Labour	4.73	2.80	7.55

Note: Figures in Table 3 were calculated using equation (4).

CONCLUSION

This study has closed the gap of extensive growth theory model by providing statistical analysis in a parametric form that removed the doubt in the results generated. The factors affecting the gross output growth of the Malaysian manufacturing sector as identified in this study using this model are the individual contributions of aggregate fiscal capital, human capital, and the combined contribution of the quality of these inputs expressed as the TFP growth.

While, the results of the study confirm that productivity growth of Malaysia's manufacturing sector is an input driven rather than TFP driven, it was also found that the slowdown of TFP growth of the manufacturing sector

industries in terms of average annual growth rates was due to the quality of inputs in general and labour involved in the manufacturing sector industries in particular.

In order to reach knowledge-based economy through the productivity of manufacturing sector the contribution of the skilled labour should be more than other two categories of labour -- semi skilled and unskilled labour, as showed in the result of this study (currently lower than them). The TFP growth of the sector must show significant increase in performance, and the result of this study also showed there is a very low contribution of TFP.

When this study was compared with that of Elsadig (2003), the results of Elsadig's study showed that the contribution of the information technology used in the manufacturing sector was the highest among the input terms and this means that achieving knowledge-based economy through IT is faster than achieving it through human capital and other traditional inputs. The impact of IT in TFP contribution is significant and better than skilled labour as an indicator of knowledge worker that showed a very low contribution of TFP. But the growth rate of TFP is lower compared with the growth rate of IT, and consequently, the achievement of the knowledge-based economy is not in a geometric progression like that of the IT development.

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<u>NOTES</u>