Contribution of Technical Change to Output Growth in Small and Medium Scale Industries: Evidence from Malaysia

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Small and medium scale industries (SMIs) play an important role in the Malaysian industrial development. SMIs comprise of more than 90 per cent of total manufacturing establishments and contribute about 40 per cent of total employments. However, its contribution to total output is very much lower than that of the large scale industries, which are mainly dominated by multinational corporations. SMIs contribute only about 30% of total output in the manufacturing sector. This phenomenon is very much related to low efficiency and moderate technology undertaken by SMIs. These two components contribute to a low total factor productivity growth. The endogenous growth model as divergence from the neoclassical growth model postulates that technology is endogenously affects output growth. Therefore, lower technology may be related to lower output growth, hence low output contribution by SMIs. This paper aims to address this issue using two steps procedures. Firstly, the analysis will look at the technical change of the SMIs sub-industries and secondly, examines to what extent technological change influence SMIs' output growth. In achieving the first objective, Data Envelopment Analysis (DEA) approach is used to estimate the Malmquist productivity index. This index has decomposed total factor productivity into technological change (TECHCH) and technical efficiency change (EFFCH). The technological change from the index is then used as independent variable in the output growth function. Other independent variables include capital and labour growth. The analysis is based on the Manufacturing Survey data collected by the Department of Statistics Malaysia, which cover 10 sub industries at three digits MSIC, from 1981 to 2003. The result shows that on average, TFP growth in SMIs is negative, due to negative contribution from technical change as well technical efficiency. Analysis by types of industries show that three sub industries that experience positive TFP growth are food and beverages, textiles and plastic products sub-industry. The contribution of technological change is greater than the technical change in most sub industries. This implies that the development of SMIs in Malaysia is very much technology oriented and not efficiency- oriented, which is preferable since the latter will reduce input cost. The result from the second estimation of output function shows that capital and labour growth as well technological change contribute positively to SMIs' output growth. This study bears some policy implications, which can be classified into three major aspects. Firstly, in order to increase efficiency, SMIs must grow bigger to enjoy economic of scales and increase their market share. Secondly, technological adoption must me tailored to the capability of SMIs in producing their products. Thirdly, SMIs must adapt product diversification through R&D activities to gain bigger market, hence enlarging production scale.

Field of Research: Economic Development, Technological Change, Small and Medium Industries, Growth

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1. Introduction

The Malaysian economy has adopted new growth strategy, which is based on productivity and knowledge driven. In this era the role of knowledge and information are becoming more important and the contribution of quality of input like quality of labour and capital to output growth will be more emphasized. The quality of labour can be enhanced through education, training and health, while the quality of capital can be upgraded through technological adoption. The appropriate technology adoption through research and development (R&D) will certainly leads to higher economic growth. The technological development that is churned out from a proper R&D will certainly contribute to higher economic growth. Additionally, promoting endogenous technology will lead to greater utilization of local resources like human resource and raw materials.

It is observed that the growth of output of Malaysian economy has been largely contributed by physical capital and labour and the contribution of TFP growth is very minimal. For example during Seventh Malaysia Plan (1996-2000), 50% of the economic growth was contributed by capital, 25% by labour and 24.8% by TFP growth. This phenomenon is also seemed in the SMIs. A study by Rahmah (2006) indicated that only few industries within SMIs enjoyed high contribution from TFP growth. This includes rubber-based, transport equipments and textiles industries. One of the TFP growth components is technical change (Nishimuzu and Page 1982) that can be obtained either from R&D expenditure, foreign direct investment or imported intermediate goods. In Malaysia R&D expenditure is still low, i.e. at about less than 1% as compared to more than about 3% in South Korea. But Malaysia has imported a significant amount of inputs, which about 80% are for the manufacturing sector, where the SMIs are in. One remaining question here is to what extent the technical change contributes to output growth in particular the growth of SMIs in Malaysia.

There are two main objectives of the paper. First, the paper calculates output-oriented Malmquist indices of Total Factor Productivity (TFP) growth, technological change (TECHCH), and technical efficiency change (EFFCH) of the Malaysian manufacturing industries. Secondly, to examine the effect of technical change on SMEs' output growth. The analysis involves two steps. In obtaining technological, technical efficiency and TFP Growth, Data Envelopment Analysis (DEA) – Malmquist Index approach is utilized. Next, using historical data, multiple regression analyses are performed to determine the relationship between the specific determinants and output growth over a twenty year period. Output growth is regressed against growth of capital, growth of labour and technical change obtained in the first step. This model is estimated using Ordinary Least Squares (OLS).

The layout of this paper is as follows. The next section provides information on the background of the small and medium scale industries (SMIs) in Malaysia Manufacturing sector. This is followed by theoretical framework and a description of the empirical model, followed by a literature review on contribution of TFPG and technical change on output growth. The following section explains the data sources, followed by discussion of the results. The sixth section concludes the paper.

2. SMIs in Malaysia Manufacturing Sector

In the Malaysian manufacturing sector, small and medium scale industries (SMIs) play an important role in generating employment and supporting the large scale industries (LSIs). With a small capital requirement and a medium level of technology, SMIs can attract many new entrepreneurs to venture into new business. In other words, SMIs act as a platform to the young and aspiring entrepreneurs.

SMIs can generate a massive employment due to the fact that their production techniques are still low or medium levels and they are more labour intensive. The role of SMIs as supporting industries to the LSEs can be viewed from interdependency between them. SMIs provide inputs, parts and components to LSIs. In fact, in the Second Industrial Master Plan (IMP2), 1996, a strong linkage between SMIs and LSIs was emphasized by the Malaysian government, which was aimed to be achieved through the development of cluster industry. If linkages can be strengthened, the dependency on the import market for obtaining intermediate inputs can be lessened, hence contributing positively to the Malaysian balance of payment.

Table 1: Relative Changes in Percentages Contribution of SMIs 1981, 1992 and 2003

	Contribution by Sector (Percentages)		
	1981	1994	2003
Number of Firms			
Small and medium size industries	94.7	84.5	86.7
Large size industries (LSIs)	5.3	15.5	13.3
Total Employment			
Small and medium size industries	28.2	31.5	26.9
Large size industries (LSIs)	72.8	68.5	73.1
Total Output			
Small and medium size industries	29.0	26.5	26.6
Large size industries (LSIs)	71.0	73.5	73.4
Total Fixed Assets			
Small and medium size industries	29.7	23.7	26.7
Large size industries (LSIs)	71.3	76.3	73.3

Source: Department of Statistics, Malaysia 2005.

In Malaysia, the majority of the manufacturing establishments are small and medium in size. Based on the Census of Establishments and Enterprises conducted by The Department of Statistics (DOS) in 2005, 86.7 percent of the establishments in the manufacturing sector were small and medium scale industries (SMEs). Even though SMEs are large in terms of number, their contribution to value added and value of fixed assets are far less than that of the large enterprises. For example, in 2003, SMEs' value added comprised only 26.6 per cent of the total manufacturing value added and 26.7 per cent of fixed assets of this sector. In term of employment, SMEs' contribution was 26.9 per cent (DOS, 2005). The detail distribution is shown in Table 1. A low level of productivity and input quality may attribute to low level of value added in the SMIs. This can be related to low skills amongst workers as well as inappropriate skill composition. The correct skill composition would produce an optimum efficiency in the production process[1].

3. The Theoretical Framework and Review of Literature

3.1. DEA Framework

Technical efficiency of small firms is central to the debate about the role of small scale industries in generating growth and employment in developing countries. Knowing their levels of efficiency, its distribution, and its correlates is critical if policymakers are to determine whether policies targeting SMIs are needed, and if so, what kinds of policies and delivery mechanisms are appropriate. The methodology we adopt to analyze firm efficiency is the data envelopment analysis. The Data Envelopment Analysis (DEA) is a special mathematical linear programming model and test to assess efficiency and productivity. It allows use of panel data to estimate changes in total factor productivity and breaking it down into two components namely, technological change (TECHCH) and technical efficiency change (EFFCH).

TFP growth measures how much productivity grows or declines over time. When there are more outputs relative to the quantity of given inputs, then TFP has grown or increased. TFP can grow when adopting innovations such as electronics, improved design, or which we call "technological change" (TECHCH). TFP can also grow when the industry uses their existing technology and economic inputs more efficiently; they can produce more while using the same capital, labor and technology, or more generally by increases in "technical efficiency" (EFFCH). TFP change from one year to the next is therefore comprised of technological change and changes in technical efficiency.

This study uses the output-oriented model of DEA-Malmquist to put much weight on the expansion of output quantity out of a given amount of inputs. Therefore, TFP index is a ratio of the weighted aggregate outputs to weighted aggregate inputs, using multiple outputs and inputs.

Input and output quantities of industries are sets of data used to construct a piece-wise frontier over the data points. Efficiency measures are then calculated relative to this frontier that represents an efficient technology. The best-practice industry determines the production frontier, that is, those that have the highest level of production given a level of economic inputs. Points that lie below the piece-wise frontier are considered inefficient while points that lie on or above the frontier are efficient.

Since many inputs are used, and shared outputs may be produced, the Malmquist approach was developed to combine inputs and outputs and then measure changes. The Malmquist index measures the total factor productivity change (TFPCH), between two data points over time, by calculating the ratio of distances of each data points relative to a common technology.

Fare *et al.* (1994) specify the Malmquist productivity change index as:

$$m_o(y_{t+1}, x_{t+1}, y_t, x_t) = [\frac{d_o^{t+1}(y_t, x_t)}{d_o^{t+1}(y_{t+1}, x_{t+1})} x \frac{d_o^t(y_t, x_t)}{d_o^t(y_{t+1}, x_{t+1})}]^{\frac{1}{2}} \quad (1)$$

The above equation represents the productivity of the production point (x_{t+1}, y_{t+1}) relative to the production point (x_t, y_t). This index uses period *t* technology and the other period *t+1* technology. TFP growth is the geometric mean of two output-based Malmquist-TFP indices from period *t* to period *t+1*. A value greater than one will indicate a positive TFP growth from period *t* to period *t+1* while, a value lesser than one will indicate a decrease in TFP growth or performance relative to the previous year.

The Malmquist index of total factor productivity change (TFPCH) is the product of technical efficiency change (EFFCH) and technological change (TECHCH) as expressed (Cabanda, 2001):

$$TFPCH = EFFCH \times TECHCH \quad (2)$$

The Malmquist productivity change index, therefore, can be written as:

$$M_0 (y_{t+1}, x_{t+1}, y_t, x_t) = EFFCH \times TECHCH \quad (3)$$

Technical efficiency change (catch-up) measures the change in efficiency between current *(t)* and next *(t+1)* periods, while the technological change (innovation) captures the shift in frontier technology.

As expressed by Squires and Reid (2004), technological change (TECHCH) is the development of new products or the development of new technologies that allows methods of production to improve and results in the shifting upwards of the production frontier. More specifically, technological change includes both new production processes, called process innovation and the discovery of new products called product innovation. With process innovation, firms figure out more efficient ways of making existing products allowing output to grow at a faster rate than economic inputs are growing. The cost of production declines over time with process innovations - new ways of making things.

Technical efficiency change, on the other hand, can make use of existing labor, capital, and other economic inputs to produce more of same product. An example is increase in skill or learning by doing. As producers gain experience at producing something they become more and more efficient at it. Labor find new ways of doing things so that relatively minor modifications to plant and procedures can contribute to higher levers of productivity.

3.2. Growth Model

Model used in exogenous growth theory consists of a production function equation in which economic output was the result of the sum of two inputs: labor and capital (Mankiw, Phelps, & Romer, 1995). As capital and/or labor increased, then output increased by the same proportion as the inputs. Actual growth was exogenous to the model. Instead of looking at growth in the context of it being a part of the equation, theorists and economists excluded it, making it exogenous to the model.

Solow (1956) added technology to the production function equation; however, he added it as a variable that existed exogenously from the neoclassical model's production function equation (Cortright, 2001; Mankiw, 1995). The neoclassical growth model of Solow (1956) focused on exogenous technological or population factors that determine output-input ratio. In this model the balanced path growth is achieved when the output and physical capital grow in tandem at the constant rate of labour force growth. This situation is also referred as the Golden Age. In this model, two key variables that determine growth are physical capital stock and quantity of labour, whereas technological progress is regarded as exogenously determined. This exogenous technology variable was meant to account for any discrepancies between what certain levels of capital and labor would indicate as the output and actual output, especially in cross-country comparisons. More importantly, it provided a vehicle for explaining the rate of growth over time. There is however a major weakness to Solow's model. By keeping technology outside of the equation, Solow's model could not explain "why" or "how", or from where/what technological progress came from (Cortright, 2001). The model therefore lacks quite a bit of explanatory power.

However, based on previous empirical results, it had been indicated that physical capital and labour inputs cannot explain completely the growth of output (Schultz 1961, Denison 1962). Most studies showed that the growth rate of output exceeds the relevant input measures, which remained in the residual. There are several possible elements within the residual. The human capital proponents suggest that human capital is probably the major explanation factor for the difference (see for example Lucas 1988; Romer 1989). Other proponents suggest the technical change may be the biggest factor in the residual that contribute to economic growth. To resolve this argument, the extended neoclassical growth model adopts an endogenous growth concept by introducing quality of labour and technological progress as a direct measure of factors of production. This new approach suggests that endogenously accumulated human capital and technical progress have direct impact on economic growth.

In the 1980's, economists recognized that growth itself had to be brought into the equation, hence, the name endogenous growth theory (Barro, 2001). Current growth theory uses the endogenous growth models, and this paper will use such a model to explain and predict SMIs output growth. This theory allowed economists to argue that technology causes increasing returns to scale. Instead of capital being limited by diminishing returns to scale, capital can be utilized in ever more efficient manners. Not only does this counterbalance the diminishing returns to scale, technology effectively offsets diminishing returns and allows theoretically limitless growth possibilities.

The endogenous growth model emphasizes on the importance of new knowledge to avoid decreasing returns to scale and this very much related to technology and research. One of the most important implications from this model is interdependence between economic variables that allow the industry to gain from the external factors such as knowledge. In other words, the main characteristic of endogenous growth model is the existence of spillover effects through R&D. In terms of knowledge, the spillover effect will be in form of transfer of ideas and technology that subsequently contribute to economic growth. Technical progress will provide incentive for capital accumulation, which subsequently increases labour productivity and economic growth.

A Cobb-Douglas production function used in this analysis is written as

$$Y = AK^{B_1}L^{\beta_2}e^{\beta_3 t+\mu} \quad (1)$$

or

$$\ln Y = InA + \beta_1 \ln K + \beta_2 \ln L + \beta_3 t + \mu \quad (2)$$

where

Y = value of output
K = value of fixed asset
L = number of employment
t = technical change
μ = error terms

3.3. Review of Literature

Many researchers argue that TFPG as a contribution of technological advancement (Katz, 1969; Abdulkhadirin and Pickles, 1990). Katz calculated residual factors to show the contribution of technological progress to output and labour productivity growth in Argentina in the period 1946-1961. He concluded that capital was the major determinant of labour productivity besides TFPG.

Abdulkhadirin and Pickles (1990) looked at the economic growth in Iraq and found that apart from technological improvement experienced by this country, capital was still the main contribution to output growth.

Chuang (1996) studied the source of growth in Taiwan's manufacturing industry and found that a major part of external effects among two digits industries was generated by trade-induced learning, which accounted for about three-fourth of the measured external effect. The study showed that the trade- induced learning variable explained most of TFPG in that sector accounted over 40% of Taiwan manufacturing output growth.

Mahadevan (2002) using the South Korean Manufacturing Industry data of 1980-1994 estimated TFPG in four industries, namely food, textile, chemical and fabricated metal using the stochastic frontier approach. She found the output growth in these four industries was increasingly productivity-driven. The export oriented industry experienced higher contribution of TFPG. Further, her study showed that in the light industry like food and textile, technical efficiency change was negative but in the heavy industry, ie, chemical and fabricated metal, it was positive.

A study by Yanrui Wu (2000) in all APEC countries using the stochastic frontier approach showed that TFPG were positive for all countries. This study includes seven APEC developed countries and nine APEC developing countries and found that APEC developed countries performed better in terms pf TFPG contribution. In all countries, the study found that technical progress was a dominant contribution of TFPG, while the technical change even though positive but very small.

In Singapore, there were few studies on TFPG in the manufacturing sector using stochastic frontier approach (Tay 1992; Renuka 2000). In this approach, TFPG can be decomposed into two parts, namely, technical progress and technical efficiency. Other studies in Singapore that measure total TFPG were done by Young (1992), Krugman (1994) and Leung (1997). The results of these studies showed that the contribution of TFPG to the output was still low.

Maisom & Arshad (1992) using data of manufacturing survey in Malaysia from 1973-1989 showed that TFPG increased each year but its contribution to the manufacturing sector growth was still small. Further in their study, it was shown that TFPG was larger in the foreign owned firms as compared to the local ones. They concluded that foreign investors had achieved higher benefits from technological progress in Malaysia.Using the same data source, Nik Hashim (1998) focused his study on the contribution of TFPG to output or productivity growth in the manufacturing sector in Malaysia as a whole between the year 1985 and 1994. No attempt was made to segregate the data by industrial size or even by types of sub-industries. His study revealed that capital was a major determinant of productivity growth, and TFPG still played a very minimal role.

Rahmah and Idris (2000) studied the contribution of TFPG to the large sacle enterprise in Malaysia using data of 1982-1994. They found that more capital intensive industries like chemical, non-metallic mineral products, transport equipment and rubber products enjoyed higher TFPG. Whereas TFPG in the light industries like food, textiles and plastics products was quite low. Rahmah and Idris (2001) studied TFPG in the small and medium scale industries using the same source of data as the earlier study. They found that the heavy industry like non-metallic mineral products, still maintain high TFPG but TFPG was higher in the light industries like food and plastics products as well in the export oriented labour intensive industries like electrical and electronics industry.

Rahmah and Nyet Fung (2002) using data of the Malaysian Manufacturing Survey of 1981-1994 studied contributin of TFPG in six manufacturing industries. They adopted the stochastic frontier approach and found that in the small scale enterprises the technical efficiency change decreased but it increased in the medium scale industries. However, the contribution of technical progress was positive in both industrial size. TFPG was higher in the medium scale industries but the contribution of TFPG to output growth was higher in the small scale.

Mahadevan (2001) studied TFPG using stochastic frontier approach using the Malaysian Manufacturing Survey data of 1981-1996. She divided the data into three periods namely 1981-1984, 1987-1990 and 1991-1996. She found that the contribution of input has increased over time but the contribution of TFPG was negative in the last two periods that due to different reasons.. During the second period, the negative contribution of TFPG was due to a negative contribution of technical progress, whereas during the third period it was due to a negative change in technical efficiency.

Using the same data set, Mahadevan (2002) estimated TFPG using data envelopment analysis (DEA) technique. She found that all 28 industries at three digits level except the petroleum industry enjoyed a positive TFPG. Most TFPG came from technical efficiency change, ie the catching effect rather than technical change/progress or frontier effect. This means that the learning-by-doing benefits or the actual diffusion in the knowledge of technology use outweighed the gains from the use of better technology and capital equipment. Further Mahadevan (2002) compare both methods of calculating TFPG, ie, the parametric method (Stochastic frontier) with the non-parametric method (DEA). Even though the results were different, both methods showed a decline of TFPG after 1990, increasing contribution of technical change and declining contribution of technical efficiency change.

The empirical literature on SMIs has used a similar methodology to estimate firm level efficiency and investigate its correlates. Some examples include Pitt and Lee (1981) on weaving firms in Indonesia; Little, Mazumdar and Page (1987) on five industrial sectors in India; and Cortes, Berry and Ishaq (1987) on metal working and food processing firms in Colombia. They adopt a two-stage approach: in the first stage, a frontier production function is estimated (or calculated by linear programming) to generate a firm-level measure of efficiency; in the second stage, this efficiency measure is regressed on various employer attributes to gain insights into the factors underlying SMI efficiency.

4. Data Source

This study used annual time series data the period 1984-2003. Data on capital, labour and value added outputs were compiled from the Annual Survey of Manufacturing Industries, published by the Department of Statistics, Malaysia. As data on capital expenditure was not published, fixed capital stock was used instead and for labour, the number of workers employed was used. The value added variable was deflated by the GDP deflator for the manufacturing sector and the capital variable was deflated using the gross domestic fixed capital formation deflator. Both deflators with 1987 as the base year were obtained from The Economic Report, published by the Ministry of Finance, Malaysia. Table 1 provides summary statistics on the manufacturing industries.

5. Empirical Results

5.1. Sources of TFP Growth

The results of the study reveal that between 1984 and 2003 TFP growth of the Malaysian manufacturing industry for the entire test period is negative due to negative contribution from both technical efficiency and technical progress. Taken individually, however, some industries are experiencing positive TFP growth and operating at its maximum potential output. There are variations in the TFP growth for the period 1985 to 2003. It reveals that only three industries, namely food and beverages; textiles and plastic products industries experiencing positive TFP growth. The remaining industries suffered a declining TFP growth over the time period. This means that only food and beverages; textiles and plastic products industries were able to cause shifts in their own frontier due to innovation. Textiles industries registered the highest TFP growth at the rate of 10.4 per cent per annum, followed by food and beverages with growth rate 7.6 per cent and plastic products industries with growth rate 4.1 per cent.

Table 3. Mean Efficiency Growth Rates over 1984 – 2003

Industry	effch	techch	pech	sech	tfpch
Food and Beverages	1.062	1.014	1.047	1.0145	1.076
Textiles	1.119	0.987	1.083	1.033	1.104
Wood products	1.028	0.965	0.823	1.249	0.993
Plastic products	1.076	0.968	1.069	1.006	1.041
Rubber products	0.839	1.035	1.014	0.827	0.869
Chemical	0.796	1.017	1.000	0.796	0.810
Metal products	0.862	1.012	0.925	0.932	0.872
Non-metallic mineral products	0.775	0.943	0.771	1.006	0.731
Electrical and electronics	0.844	0.952	0.842	1.003	0.804
Transport equipment	0.726	0.956	0.731	0.993	0.694
Overall	0.916	0.987	0.933	0.982	0.904

Source of TFP growth for the food and beverages, textiles, wood and plastic products was mainly due to technical efficiency change, with an index growth ranging from 1.028 to 1.119. These four industries are operating at its optimum potential output. This result reveals that the growth in these industries was boosted by the enhancement of their productivity-based catching-up capability, specifically the effective use of human capital in the labor market and the adoption of the new technology. The least efficient industry is that of transport equipment which could increase its output by 27.4 per cent without increasing the use of its inputs. All the remaining industries are inefficient industries. The results reflect that technical efficiency does not depend on capital intensity because some of these industries are highly capital- intensive. On the other hand, industries that are more labour- intensive like food and beverages is very efficient

5.2. Contribution of Technical Change to Output Growth

The DEA methodology yields estimates of a firm-specific efficiency index that ranges from 0 to 1, where a firm with an index of 1 is operating at its maximum potential output. In this section, the technological change from the index is then used as independent variable in the output growth function. Other independent variables include capital and labour growth.

Table 4 shows results of regression analysis of equation (4) using OLS procedure. Serial correlation test of the first order were carried out. The test indicates the evidence of first order serial correlation in the textiles, rubber products and chemicals sub-industries. Therefore, further estimation using iterative Cochrane-Orcutt procedures is performed to correct this problem.

The value of R^2 in all but SMIs subgroups is greater than 0.7 indicating that the independent variables explain more than 70 per cent in the variation of the dependent variables respectively. The value of R^2 for rubber products sub-industries is only 0.2073.

In six of the SMIs subgroups the results show that the TECHCH significantly determines the output growth. Exception is found in the rubber products, chemical, metal products and non-metallic mineral products. Labour input growth is a significant determinant of output in eight of SMIs sub-groups except in textiles and rubber products. On the contrary, capital input growth is a significant determinant of output in six of SMIs sub-groups except in plastic products, rubber products, metal products and transport equipment.

Analysis by SMIs sub-groups show that in the rubber products none of the incorporated inputs growth and TECHCH significantly determines its output growth. Both the input growths significantly explain the output growth in food and beverages, wood based, chemical, non-metallic mineral products and electrical and electronic. In the wood-based a one percent increase in labour growth will increase output growth by 0.874 percent, whereas, a one percent increase in capital growth will increase output growth by 1.792 percent. For the chemical, a one percent increase in capital growth will increase output by 0.815 percent, whereas, a one percent increase in labour growth will increase output growth by 0.533 percent. In the non-metallic mineral products, a one percent increase in labour growth will increase the output growth by 0.309 percent, whereas, a one percent increase in the growth of capital will increase output growth by 0.813 percent. In these three sub-groups, the effect of capital growth outweigh the impact of labour growth. In contrast, the effect of labour growth are greater in the other two sub-groups, namely food and beverages, and electrical and electronics.

Table 4: Results of Output Growth Regression Analysis In SMEs 1984-2003

INDUSTRY	Intercept	Capital	Labour	Trend	R^2	LM test[1]
Food and Beverages	2.2601 (2.694)	0.3202** (2.332)	0.5828* (2.010)	0.1421* (1.744)	0.75778	
Textiles	0.7975 (0.766)	1.0103** (2.162)	0.1953 (0.814)	0.2029** (2.252)	0.7384	5.6239 (0.01771)
Wood products	1.8327 (2.349)	1.7920*** (3.891)	0.8742*** (4.039)	0.3270* (2.033)	0.7167	
Plastic products	1.8541 (1.873)	0.1852 (0.233)	0.8983* (2.025)	0.1841** (2.593)	0.8834	
Rubber products	4.1578 (4.747)	0.0387 (0.195)	0.0650 (0.938)	0.0815 (1.091)	0.2073	5.9518 (0.01470)
Chemical	-0.1045 (-0.114)	0.8151** (2.519)	0.5325** (2.842)	0.0245 (0.393)	0.7683	10.6049 (0.00113)
Metal products	1.1329 (1.801)	0.1666 (0.430)	0.7577*** (3.306)	0.0244 (0.341)	0.8009	
Non-metallic mineral products	0.8569 (0.912)	0.8127** (2.186)	0.3094* (1.686)	0.0369 (1.6468)	0.7758	
Electrical and electronics	2.9883 (1.975)	0.8580* (1.855)	1.2005*** (6.846)	0.1373* (1.844)	0.8221	
Transport equipment	3.0117 (3.530)	1.2668 (1.730)	1.4082*** (3.149)	0.0960* (1.796)	0.7893	

[1] Breusch-Godfrey Serial Correlation LM Test: $(n-1)R^2$

The figures in the parentheses below the estimated value of LM test are their probability of Chi-square(1)

Figures in parentheses are t-values

*** - significant at 1 per cent

** - significant at 5 per cent

* -significant at 10 per cent

6. Summary and Conclusions

The above discussion reveals that in general TFP growth in SMIs is negative due to negative contribution from both technical efficiency and technical change. However, analysis by sub industries indicates some positive TFP growth especially in the light industries like food and beverages, textiles and plastic products that merely come from positive contribution of technical efficiency. The heavy SMIs like transport equipment and chemical products seem less efficient and at the same time do not gain positive growth in technical change that subsequently resulted in negative growth of TFP.

Further, the study finds that technical change is a significant determinant of SMIs output growth in six sub industries, namely, food and beverages, textiles, wood products, plastic products, electrical electronics and transport equipment. In other industry sub groups the relationship are positive but not significant. This implies that technical change plays an important role in determining SMIs' output growth regardless of heavy or light industries, capital intensive or labour intensive.

The results from this study bear some policy implication regarding SMIs' development in Malaysia. The negative TFP growth implies inefficiency in SMIs. In order to increase efficiency, SMIs must grow bigger to enjoy economies of scale. The enlargement in scale operation will reduce average cost and increase workers' productivity, hence firms' efficiency. Since technical change was found to be negatively grown, enhancement in R&D will spur technological development and progress. The SMIs must increase R&D expenditure, to venture in product development through diversification. Through this SMIs will be able to expand their markets.

As a conclusion, we may suggest the government to give greater emphasis on the development of SMIs as they are a pillar to Malaysian industrial growth. SMIs themselves must grab all possible opportunities given by the government. There are enormous government supports and programs in all aspects like financial, technical, human resource development and marketing for SMIs' development in Malaysia.

ENDNOTES

1. MIDA defines skilled workers as those who obtain certificate from the vocational schools or Industrial Training Institutes. The Ministry of Human Resource defines skilled workers as those who receive training for a period of more than 6 months, whereas semi-skilled workers are those who receive 3-6 months training. The Department of Statistics defines skilled workers as those who receive formal training for their specific job (either in service training or other type e.g. formal training in an institution). Unskilled workers are those who have not received any formal training for job they are performing. Semi-skilled workers are those who are not classified either as skilled or unskilled.

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