TECHNICAL EFFICIENCY AND TECHNOLOGICAL CHANGE IN MALAYSIAN SERVICE INDUSTRIES

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ABSTRACT

This article examines the total factor productivity (TFP) growth by decomposing it into technical efficiency and technological change for the 20 service industries in a developing country - Malaysia from 1987-1992. On average, the TFP growth of the service industries experienced positive TFP growth of 1.8%. The contributing factors for TFP growth was technical efficiency while technological regress was found to dampen the TFP progress.

Keywords: Technical Efficiency; Total Factor productivity; Service Industries; Technological change

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I. INTRODUCTION

Malaysia has moved into the second tier of newly industrialized economies. Malaysia's gross domestic product (GDP) during 1971-1990 and 1990-1999, grew at an average rate of 6.7% and 8.1% per annum respectively, out performing other ASEAN economies (Malaysia 1971 & 1990). This success was mainly attributed to the manufacturing sector. However in recent years, the service sectors have emerged as one of the dominating sectors. For instance, in 2000, the service sector's percentage contribution to GDP in Malaysia excluding government services was 45.2%. Yet, very little attention has been given in regards to the performance and sustainability of these sectors. Hence, measuring the TFP creates an avenue to measure the performance of these sectors while providing valuable guidance on issues of sustainability. Thus, this article intends to bridge the existing research gap by examining the TFP growth in the selected service sectors.

This article contributes in the following ways. First, the non-parametric frontier analysis was used to assess the TFP. Second, while many studies concentrated on the manufacturing sectors (Kalirajan & Tse, 1989; Tham, 1997; Mahadevan, 2002a) this article examines the service sector. Third, the use of more disaggregated data (industry level) significantly reduce some of the weaknesses of the aggregated production function in assessing TFP (Felipe, 1999).

II. METHODOLOGY AND DATA

By means of a panel data of 20 service industries, given the inputs, TFP indices are measured using the Malmquist index that measures the output distance functions. The Malmquist output-based productivity index between period t+1 and t is given as specified by Fare et al., (1994) as follows:

$$Mo\,(y^{t+1}, \mathrm{x}^{t+1} y^{t}\ \mathrm{x}^{t}) = \left[\frac{\mathrm{d}_{o}^{t}(\mathrm{x}^{t+1}, y^{t+1})}{\mathrm{d}_{o}^{t}(\mathrm{x}^{t}, y^{t})} \mathrm{x}\ \frac{\mathrm{d}_{o}^{t+1}(\mathrm{x}^{t+1}, y^{t+1})}{\mathrm{d}_{o}^{t+1}(\mathrm{x}^{t}, y^{t})}\right] 1/2 \quad (1)$$

Where,

$Mo(y^{t+1}, x^{t+1}, y^{t}, x^{t})$ – is the output based productivity index of the most recent production unit, using period *t+1* technology relative to the earlier production unit, with respect to *t* technology.

Do is the output distance function

y t + 1– represents output in period *t +1*

x t + 1 – represents input in period *t +1*

y t – represents output in period *t*

x t – represents input in period

A positive growth of TFP is indicated by *Mo* value greater than unity whereas a decline is represented by a value of less than unity. To compute equation 1, we are required to calculate four component distance functions which will involve 4 linear programming (LPs), thus with 6 years and 20 industries, 320 LPs must be solved.[1] The LPs are:

$$\left[d_{o}^{t}(y_{t}, x_{t}\right]^{-1} = \max_{\phi\lambda}\phi$$

st

$$-\phi y_{it} + Y_{t}\lambda \geq 0,$$
$$x_{it} - X_{t}\lambda \geq 0,$$
$$\lambda \geq 0,$$

$$\left[d_{o}^{s}(y_{s}, x_{s}\right]^{-1} = \max_{\phi\lambda}\phi,$$

st

$$-\phi y_{is} + Y_{s}\lambda \geq 0,$$
$$x_{is} - X_{s}\lambda \geq 0,$$
$$\lambda \geq 0,$$

$$\left[d_o^t(y_s, x_s)\right]^{-1} = \max_{\phi\lambda}\phi$$

st

$$-\phi y_{is} + Y_t\lambda \geq 0,$$
$$x_{is} - X_t\lambda \geq 0,$$
$$\lambda \geq 0,$$

and

$$\left[d_o^s(y_t, x_t)\right]^{-1} = \max_{\phi\lambda}\phi$$

st

$$-\phi y_{it} + Y_s\lambda \geq 0,$$
$$x_{it} - X_s\lambda \geq 0,$$
$$\lambda \geq 0,$$

where;

y_{it} is a MX1 vector of output quantities for the i-th industry in the t-th year;
x_{it} is a KX1 vector of input quantities for the i-th industry in the t-th year;
Y_t is a NXM matrix of output quantities for all N industries in the t-th year;
X_t is a NXM matrix of input quantities for all N industries in the t-th year;
λ is a NX1 vector of weights and
ϕ is a scalar

The TFP index is further decomposed into technical efficiency change (TE), and technological change (TC) (Fare *et al.*, 1994; Coelli, 1996). TE is attributed to the practices of best available techniques, which involve the efficient use of inputs (catching up effect) while TC measures the benefits of better technology and capital equipments or simply put innovation (the frontier effects). The decomposition of TFP would make a distinction in terms of policy formulation since changes in either one component will require different policy direction (Nishimizu & Page, 1982). The TFP growth is decomposed into TE and TC as;

$$Mo\,(y^{t+1}, \mathrm{x}^{t+1}, y^t, \mathrm{x}^t) = \left[\frac{\mathrm{d}^{t+1}(\mathrm{x}^{t+1}, y^{t+1})}{\mathrm{d}^t(\mathrm{x}^t, y^t)}\right]\left[\frac{\mathrm{d}^t(\mathrm{x}^{t+1}, y^{t+1})}{\mathrm{d}^{t+1}(\mathrm{x}^{t+1}, y^{t+1})}\ \mathrm{x}\ \frac{\mathrm{d}^t(\mathrm{x}^t, y^t)}{\mathrm{d}_o^{t+1}(\mathrm{x}^t, y^t)}\right]1/2 \qquad (2)$$

(TFP) (TE) (TC)

Additionally, the TE can be further decomposed into scale efficiency change (SE) and pure efficiency (PE) change as suggested by Fare *et al*. (1994). Thus, the enhanced decomposition of Fare *et al*. (1994) can be presented as TFP Growth = SE x PE x TC, where, TE = SE x PE.

The measure of output is based on gross revenue deflated by the consumer price index for the respective industries. Two inputs namely labour (total number of workers) and capital (fixed capital assets deflated by producer price index for goods in the domestic economy particularly for manufactured goods) were used. Data were obtained from Malaysia Economic Statistics – Time Series 2002 report. Due to data limitations, analysis was only covered from 1987 to 1992.

III. EMPIRICAL RESULTS

As shown in Table 1, the service industries experienced an overall positive TFP growth of 1.8%, which is shown by a TFP mean of more than unity. On the other hand, at the industry level, 12 out of 20 service industries enjoyed positive growth of TFP. The positive growth of TFP was mainly due to the improvement in technical efficiency of about 7.1%. In contrast, technological change (-5.3%) dampened the TFP growth of the services industries. Unlike the Singapore experience which shows limited technological efficiency (Mahadevan; 2002b), in Malaysia the poor TFP growth was mainly due to technological change. The corollary is that these industries have experienced lack of benefits from better technology and capital equipments due to the limited technology transfer or the know-how via foreign direct investment (FDI). Pramanik (1994) indicated that the over reliance on the domestic markets coupled with the absence of external competition owing to limited liberalization of service industries has not made these industries cost effective.

TABLE 1: MALMQUIST INDEX OF INDUSTRY MEANS (1987-1992)

Industries	TFP Change	Tech. Change	TE Change	PE Change	SE Change
Acct. auditing & bookkeeping Services	0.985	0.887	1.111	1.110	1.001
Advertising Services	0.965	0.965	1.000	1.000	1.000
Architecture Services	1.016	0.887	1.146	1.130	1.014
Land Transport Services	0.993	0.970	1.023	0.843	1.214
Entertainment Services	1.054	1.050	1.003	1.001	1.002
Medical Services	1.030	0.945	1.089	1.086	1.003
Engineering Services	1.071	0.887	1.208	1.195	1.010
Hotel and Other Lodging	1.088	1.050	1.036	1.209	0.857
Legal Services	0.984	0.887	1.110	1.109	1.001
Healthcare Services	1.085	1.050	1.033	1.029	1.004
Education Services	1.070	0.970	1.103	1.096	1.006
Real Estate Services	0.971	0.887	1.095	1.041	1.051
Road Haulage Services	1.016	0.989	1.027	1.000	1.027
Freight forwarding & brokerage	1.004	0.958	1.048	1.028	1.019
Water Transport Services	0.974	1.050	0.927	1.000	0.927
Water Transport Support	0.946	0.887	1.067	1.076	0.991
Finance	1.052	0.967	1.087	1.079	1.007
Surveyors	1.009	0.887	1.138	1.129	1.008
Tourist and Travel	1.094	0.960	1.139	1.130	1.008
Veterinary	0.966	0.909	1.063	1.000	1.063
Mean	**1.018**	**0.950**	**1.071**	**1.061**	**1.009**

[Note that all Malmquist index averages are geometric means]
Due to rounding, growth rates above may not add up. Window analysis was performed to assess the stability of the efficiency rating of each industry over time by moving average approach.

Industries with positive TC (entertainment, hotel & lodging, health care and water transport services) may have benefited from smart partnership with global players via transfer of technology[2]. With regards to SE, value close to unity shows that most industries are operating at optimum scale. A positive trend in PE was also exhibited in most of the industries. Thus, both the SE and PE have contributed towards the improvement of TE.

IV. CONCLUSION

We know great deal of productivity paradox of the manufacturing industries of Malaysia but comparatively little is known about the service industries. Evidence indicated that Malaysia's service industries experience a positive TFP growth but little progress is seen in terms of technological change. Following the trend of these service industries that rely on human capital, effort should be made to enhance the technological adaptation to further improve the TFP growth. Therefore, policy directed towards implementation of best technologies would prove to be beneficial for the sustainability of these service industries.

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Notes:

1. For details on Malmquist DEA see Fare et al., 1994 and Coelli, 1996 for the guide to DEAP computer program.
2. Certain industries namely shipping, banking, insurance and finance experience quite substantial FDI inflows (Nga, 1988)

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