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Productivity, Technical and Efficiency Change in Singapore's Services Sector, 2005 to 2008

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Abstract:

The current study was motivated by statements made by the Economic Strategies Committee that Singapore's recent productivity levels in services were well below countries such as the US, Japan and Hong Kong. Massive employment of foreign workers was cited as the reason for poor productivity levels. To shed more light on Singapore's falling productivity, a nonparametric Malmquist productivity index was employed which provides measures of productivity change, technical change and efficiency change. The findings reveal that growth in total factor productivity was attributed to technical change with no improvement in efficiency change. Such results suggest that gains from TFP were input-driven rather than from a 'best-practice' approach such as improvements in operations or better resource allocation.

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Keywords: Efficiency, productivity; Malmquist indices; Singapore services.

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1. Introduction

Before Krugman's (1994) paper, Singapore's emphasis on productivity was evident in the 1970s with the establishment of the National Productivity Board in 1972. In the1980s the Singapore Government launched the National Productivity Movement with frequent productivity campaigns accompanied by mascots like 'Teamy the Bee' and slogans such as "Together We Work Better" and "Train Up - Be the Best You Can Be". Hence, when Krugman (1994) argued that Singapore's growth was mainly driven from factor accumulation and not through efficiency, it struck a nerve in the Singapore government and initiated an ambitious plan of productivity-driven programs and initiatives to address this issue.

In 1996, the National Productivity Board (NPB) and the Singapore Institute of Standards and Industrial Research merged to form the Singapore Productivity and Standards Board (PSB), a statutory board under the Ministry of Trade and Industry. Its mission was to spearhead the National Productivity Movement and raise the productivity standards via ten-year plans such as 'Productivity Action 21' (ProAct 21), Small and Medium Enterprises 21 (SME 21) and Retail 21.[1] In 2002, PSB's productivity-related functions were transferred to the Standards, Productivity and Innovation Board (SPRING). SPRING Singapore, a statutory board under the Ministry of Trade and Industry, aimed to promote innovation as a key contributor of productivity growth with focus on transforming Singapore into a knowledge-driven economy.

However, in 2010 the Economic Strategies Committee (henceforth ESC) reported that Singapore's productivity from 2006 to 2008 was well below levels of the US, Japan and Hong Kong. The major concern for the ESC was the poor productivity level in services. Labour productivity change in services drawn from the *Yearbook of Statistics 2010* had declined from 6.4 percent in 2004 to -3.5 percent in 2008, and -4.9 percent in 2009. Negative productivity poses a significant problem as it lowers a country's competitiveness, which would be

[1] These plans were launched in 1999, 2000 and 2001, respectively.

detrimental to Singapore's economic growth especially with services being the main contributor to its Gross Domestic Product (GDP).[2]

There have been several productivity studies on Singapore at the national level and service sector level. At the national level, studies include Kim and Lau (1994), Krugman (1994), Rao and Lee (1995) and Toh and Low (1996), while service sector studies include Tan and Virabhak (1998), Mahadevan (2000) and Kong and Tongzon (2006). These studies however focused on the years prior to 2000. As far as the author is aware, there has not been any official published productivity study on Singapore's service sector since 2000. The current study aims to fill this void with a focus on the services sector motivated by the comments made by the ESC (2010) that Singapore's poor productivity in services has now become a growing concern.

The recent poor productivity performance has been closely linked with the mass employment of low-skilled foreign workers. While an influx of foreign workers would tend to have an impact on labour productivity, this measure of productivity does not accurately measure a country's productivity performance such as those reported in ESC 2010. It is more important to measure productivity in terms of total-factor productivity (TFP) since TFP is the portion of output not explained by the amount of inputs used in production. As such, its level is determined by how efficiently and intensely the inputs are utilised in production. The other motivation of the paper is to shed light on whether there have been any improvements in efficiency from the various plans and initiatives of the PSB and SPRING since Krugman's (1994) comment that Singapore's growth was largely input-driven with negligible efficiency.

The aim of this paper is two-fold: first, to measure and attempt to explain productivity change in the sectors within Services; and second, to seek out and determine any growth in efficiency which may indicate effectiveness of the plans and initiatives of SPRING. The estimates of productivity growth in Singapore's service sector over the period 2005 to 2008

[2] The services sector contributed about 62 percent to GDP and employed about 77 percent of total employment. (Singapore Department of Statistics, 2007 and 2010).

are derived using the Malmquist productivity index.[3] This approach has two distinguishing features that make it ideal for a study such as this: first, it does not require prices of resources used and services provided, and it does not require a behavioural assumption such as profit maximisation in competitive markets; and second, sources of any productivity change are established by decomposing the Malmquist productivity index into efficiency change (catching-up to the best-practice frontier) and technical change in the production frontier.

The paper is divided into five sections. Section 2 describes the Malmquist productivity index and its decomposition. Section 3 describes the inputs and output employed. Section 4 presents the empirical results in terms of productivity change, technical change and efficiency change. The paper concludes with some brief remarks.

2. Malmquist Productivity Index

The current study employs the nonparametric input-oriented Malmquist productivity index that decomposes productivity change between two periods into technical change and efficiency change. Input-orientation refers to the emphasis on the equiproportionate reduction of inputs (x) within the context of a given level of output (y). The Malmquist productivity index has been adopted by many studies that analyse productivity change at the industry level. Such studies include Färe, Grosskopf, Lindgren and Roos (1992) in the pharmaceutical industry, Hjalmarsson and Veiderpass (1992) in electricity retail distribution, Price and Weyman-Jones (1996) in the gas industry, Fukuyama (1995), Gilbert and Wilson (1998), Rezitis (2006), Guzmán and Reverte (2008), Chiu, Ma and Sun (2010) and Lee, Worthington and Leong (2010) in banking and finance services, Worthington and Lee (2008) and Kempkes and Pohl (2010) in higher education, Odeck (2007) and Balcombe, Davidova and Latruffe (2008) in agriculture and Reichmann and Sommersguter-Reichmann (2010) in university library. A detailed description of the Malmquist productivity index is found in Fare,

[3] The study period 2005 to 2008 was chosen as these were the years that showed a significant fall in productivity.

Grosskopf and Lovell (1994) and Coelli, Rao and Battese (1998). Following Fare, Grosskopf and Lovell (1994), the input-oriented Malmquist productivity change index is expressed as:

$$M^{I}_{t+1}(y_{t+1}, x_{t+1}, y_t, x_t) = \left[D^{I}_{t}(y_{t+1}, x_{t+1}) / D^{I}_{t}(y_t, x_t)\right] \times \left[D^{I}_{t+1}(y_{t+1}, x_{t+1}) / D^{I}_{t+1}(y_t, x_t)\right]^{1/2} \quad (1)$$

where the superscript *I* indicates an input-orientation, *M* is the productivity of the most recent production point (x_{t+1}, y_{t+1}) (using period $t + 1$ technology) relative to the earlier production point (x_t, y_t) (using period t technology), *D* are input distance functions, and all other variables are as previously defined. Values greater than 1.00 indicate total factor productivity (TFP) growth between the two periods. Equation (1) can be further re-written as:

$$\begin{aligned} M^{I}_{t+1}(y_{t+1}, x_{t+1}, y_t, x_t) &= \left[D^{I}_{t+1}(y_{t+1}, x_{t+1}) / D^{I}_{t}(y_t, x_t)\right] \times \\ &\left[\left(D^{I}_{t}(y_{t+1}, x_{t+1}) / D^{I}_{t+1}(y_{t+1}, x_{t+1})\right) \times \left(D^{I}_{t}(y_t, x_t) / D^{I}_{t+1}(y_t, x_t)\right)\right]^{1/2} \end{aligned} \quad (2)$$

where

$$E = \left[D^{I}_{t+1}(y_{t+1}, x_{t+1}) / D^{I}_{t}(y_t, x_t)\right] \quad (3)$$

$$T = \left[\left(D^{I}_{t}(y_{t+1}, x_{t+1}) / D^{I}_{t+1}(y_{t+1}, x_{t+1})\right) \times \left(D^{I}_{t}(y_t, x_t) / D^{I}_{t+1}(y_t, x_t)\right)\right]^{1/2} \quad (4)$$

M (Malmquist TFP) is the product of a measure of technical change *T* ('frontier-shift' or 'best-practice frontier' effect) measured by shifts in the frontier between period $t + 1$ and period *t* and *E* ('catch-up' effect) is the efficiency change over the same period, which measures how much closer to the frontier the firm/industry is by capturing the extent of knowledge of technology use either from changes in improved resource allocation or reduction in organisational slack. Three primary results are derived from the Malmquist indices of productivity growth as expressed in equation (2). First, the measurement of TFP change; second, the decomposition of TFP change into technical change (equation 4) and efficiency change (equation 3); and third, efficiency change is further decomposed into pure technical efficiency (PTE) and scale efficiency (SE), which helps explain the main sources of improvement.

3. Data and Input/Output Specification

Data were drawn from the Singapore Department of Statistics, *Economic Surveys Series: The Services Sector* from 2005 to 2008. The Economic Surveys Series identifies nine service sectors and these are listed in Table 1.

Table 1

No.	Name of Sector
1	Wholesale
2	Retail
3	Transport and Storage services
4	Accommodation Services (eg. hotels, lodging & boarding houses and chalets)
5	Food and Beverages Services
6	Information and Communications Services
7	Financial and Insurance Services
8	Real Estate and Business Services
9	Community, Social and Personal Services

Following the framework similar to Kong and Tongzon (2006), we use one output (value added) and four inputs (number of establishments, number of hours worked, operating expenditure and remuneration) of which the first three are quantitative measures while the fourth is a qualitative measure of service. The input 'number of hours worked' is used as it is a better form of labour input than 'number of employees' since the former measures labour intensity more adequately. All monetary values are converted into 2005 prices to account for inflationary effect. Value added was deflated using Gross Domestic Product (GDP) deflators while 'remuneration' and 'operating expenditure' were deflated using Consumer Price Indices (CPI). Both GDP deflators and CPI are drawn from the *Yearbook of Statistics 2010*. Kong and Tongzon (2006) also included 'business cycle' to measure the impact on TFP. In the current paper, this variable is excluded for the simple reason that the timeframe concerned is short and that the period in concern had no major business fluctuations. If the time frame were extended to 2009, then 'business cycle' would be a significant variable in the model as 2008 to 2009 saw the advent of the 'Global Financial Crisis', which resulted in fluctuations in the business cycle and had a profound impact on sectors such as finance, business and real estate.

4. Empirical results

This section presents results based on the Malmquist productivity index detailed in Section 2, under the assumption that all service sectors operate under constant returns-to-scale. These results are presented and analysed in Tables 2 and 3.

Table 2: TFP, Technical Change and Efficiency Change of Singapore's Service Sector, 2005-2008

	TFP change	Technical Change (T)	Efficiency Change (E)	Pure Technical Efficiency (PTE)	Scale Efficiency (SE)
2005-06	1.001	1.028	0.974	0.984	0.990
2006-07	0.992	1.022	0.970	0.991	0.978
2007-08	0.942	0.944	0.997	1.010	0.987
Mean	0.978	0.997	0.980	0.995	0.985

Table 2 shows the mean annual figures for TFP change, efficiency change and technical change for the period 2005-2008. There was a mean decrease in TFP of -2.2 percent largely from reduction in efficiency change (E) of -2.0 percent. On a year-on-year basis, TFP growth had been declining from 0.1 percent to -5.8 percent per annum. The services sector on average suffered declining growth, especially in 2007-08 with both T and E experiencing negative growth. To ascertain the contributions to the fall in mean TFP, efficiency change is further decomposed into pure technical efficiency (PTE) and scale efficiency (SE) (presented in Table 2).

For the period 2005-08, mean PTE and SE posted negative growth of -0.5 percent and -1.5 percent, respectively. In all three years, SE exhibited negative growth thus contributing to the decline in efficiency change over this time period. This change indicates that service sectors performing inefficiently could have saved, on average, 2.0 percent of (that is, 1 – E) input quantities if they had adopted best practice technology. In terms of optimal size, cost savings could have been 1.5 percent (1 – SE), 0.5 percent more if appropriate management practices were followed.

The negative growth of efficiency for the period 2005 to 2008 suggests that the plans and initiatives of the PSB and SPRING were to some extent ineffective. The effectiveness of the ten-year plans of ProAct 21, SME 21 and retail 21 in terms of growth in efficiency,

launched in 1999, 2000 and 2001 respectively, should have been realised between 2005 and 2008. On a year-on-year basis, only 'Wholesale' services posted growth in efficiency for periods 2005-06 and 2006-07.[4] This outcome might suggest that, in the short-run, the initiatives proved rather effective since SME 21 would have its main focus on 'Wholesale' services. On the whole, the slow-down in technical growth in Table 2 suggests diminishing returns due to factor accumulation. From these observations, the effectiveness of the plans and initiatives is only for the short-term, which suggests that continuous factor accumulation, as noted by Krugman (1994), is not sustainable for long-term TFP growth.

Table 3 presents the mean TFP scores for each service sector for the period 2005 to 2008 and also ranks the sectors accordingly. The key aspect of this part of the discussion is to determine which sectors were the main contributors to lagging productivity in Singapore's service sector. Two sectors posted positive TFP growth - 'Financial and Insurance Services' (4.7 percent) and 'Accommodation Services' (0.7 percent). The worst performers were 'Food and Beverages Services' (-6.7 percent) and 'Retail' (-5.3 percent).

Table 3: Ranked TFP scores by service sector (annual mean), 2005-2008

	TFP	Technical Change (T)	Efficiency Change (E)	Pure Technical Efficiency (PTE)	Scale Efficiency (SE)	Rank
Wholesale	0.968	0.986	0.982	1.000	0.982	5
Retail	0.947	0.997	0.949	0.960	0.989	8
Transport and Storage Services	0.985	0.985	1.000	1.000	1.000	4
Accommodation Services	1.007	1.007	1.000	1.000	1.000	2
Food and Beverages Services	0.933	0.991	0.942	0.993	0.948	9
Information and Communications Services	0.971	0.986	0.984	1.004	0.980	6
Financial and Insurance Services	1.047	1.047	1.000	1.000	1.000	1
Real Estate and Business Services	0.989	1.008	0.981	1.000	0.981	3
Community, Social and Personal Services	0.961	0.973	0.988	1.000	0.988	7
Mean	0.978	0.997	0.980	0.995	0.985	

From Table 3, most services had negative TFP growth. TFP growth for the top two performing services, 'Financial and Insurance Services' and 'Accommodation' was due to

[4] Growth for efficiency change for these two periods was 1.4 and 5.2 percent, respectively.

technical change with no change in efficiency, which suggests that Krugman's (1994) explanation of Singapore's growth was mainly input-driven with negligible efficiency. TFP growth for these services was attributed to increased inputs as shown in the changes in T (Table 3) and no improvements in efficiency (E). As noted in Tables 2 and 3, over the study period 2005 to 2008, there was a slow-down in TFP growth in the services sector with several sectors experiencing negative TFP growth due to reduction in both T and E. This pattern of falling TFP growth and falling T suggest factor accumulation is unsustainable for long-term growth (also noted in Krugman, 1994 and Mahadevan, 2000).

The results of 'Financial and Insurance Services' are similar to the findings of Mahadevan (2000), although the latter's study focused on a different time-period. This sector enjoyed positive TFP growth due to Singapore's drive to become a major financial centre and business hub, a drive that continues to this day. Since the late 1990s, deregulation has opened up the financial sector and made it internationally competitive. Singapore's desire to be a financial hub as well as a city striving to be a top tourist destination would no doubt attract foreign businesses and tourists, thus suggesting some flow-on impact onto the TFP growth of 'Accommodation Services'.

The worst performers were 'Food and Beverages Services' and 'Retail' with TFP of -6.7 and -5.3 percent, respectively. Kong and Tongzon (2006) also found 'Food and Beverages Services' to be the worst TFP performer.[5] Decline in 'Food and Beverages Services' TFP was due to falling technical change (-0.9 percent) and efficiency change (-5.8 percent). Negative technical change suggests excessive factor accumulation while falling SE which mainly contributed to negative efficiency change suggests that optimal operation size of 'Food and Beverages Services' can be achieved by reducing its scale of operations by 5.2 percent.

Deterioration in 'Retail' performance was mainly due to falling efficiency change of -5.1 percent, of which PTE (i.e.. inefficient operations) contributed -4.0 percent and SE

[5] Kong and Tongzon (2006) identify this sector as 'Catering' which is mainly services in 'Food and beverages'.

contributed -1.1 percent. A higher SE value over PTE value suggests that 'Retail' should first improve the allocation of input and output factors to better pure technical efficiency, and then expand operational scale to upgrade scale efficiency in order to boost the overall efficiency.

Some key features of 'Food and Beverages Services' and 'Retail' services needs mentioning and which may suggest their low productivity. These services hire significant numbers of foreign workers thus demonstrating that over-utilisation of foreign workers has indeed lowered productivity levels.[6] From the results of Table 3, it is also worth noting that controlling the employment levels of foreign workers is not a long-term solution as there is also the need to adopt best-practice management, which is indicated in the falling efficiency change. Appropriate allocation of inputs needs to be adopted as well as improving the scale of operations in 'Food and Beverages Services'. Low SE in 'Food and Beverages Services' indicates failure to achieve economies of scale. In 2007, the majority of establishments (58 percent) comprised of cafes, coffee houses, snack bars, food courts, coffee shops, eating houses, pubs and canteens.[7] Being small in size, it is unlikely that economies of scale can be achieved, compared to chain restaurants and fast-food outlets that have the capacity to do so. Economies of scale can be achieved either through franchising or mergers. While franchising may not be feasible for small establishments such as hawker stalls, mergers may be a possibility. Mergers of food and beverage outlets forming into food courts such as 'Kopitiam' and 'Banquet' have been around for some time, but since their numbers are still relatively small compared to the number of independent cafes and coffee shops, this might suggest that operational efficiencies of food courts are being over-shadowed by the inefficiencies of the small establishments within the 'Food and Beverages Services' sector. Hence, improvement in productivity levels in these services requires more than just monitoring the numbers of foreign workers; it also needs improved efficiency change through adoption of best practices.

[6] 'Construction' sector also hires considerable number of foreign workers but this sector is not covered in the study.

[7] This majority is in terms of employment size. The proportion of establishments hiring less than ten persons was 58 percent (3049 out of 5244).

'Retail' also faces a similar problem as 'Food and Beverages Services'. In 2007 this sector was comprised mainly of establishments hiring less than ten persons.[8] Low SE suggests poor scale of operations, but its lower PTE further shows that there is a greater need to allocate inputs more appropriately.

Bootstrapping

In this section, we test the reliability of results via statistical inference using the bootstrap approach of Simar and Wilson (1999). Confidence intervals at 0.05 level are estimated in order to assess the 'null hypothesis' of insignificant productivity change, efficiency change and technical change, which predicts that the corresponding measures are not statistically different from unity. As our sample size is rather small, bootstrapping replicates our dataset to generate an appropriately large number of pseudo-samples of B = 2000. Tables 4, 5 and 6 present the changes in productivity, efficiency and technology for the nine services sectors and include the lower and upper bounds of the 95 percent confidence intervals. The results in these tables show no statistical significance, thus the 'null hypothesis' cannot be rejected.

Table 4: TFP Change, 2005-2008

	2005-06	**2006-07**	**2007-08**
Wholesale	1.011	1.034	0.867
Retail	0.918	0.949	0.974
Transport and Storage services	0.997	1.011	0.947
Accommodation Services	1.041	1.056	0.928
Food and Beverages Services	0.954	0.933	0.913
Information and Communications Services	0.977	0.963	0.972
Financial and Insurance Services	1.120	1.074	0.953
Real Estate and Business Services	1.040	0.954	0.973
Community, Social and Personal Services	0.967	0.962	0.954
Confidence Intervals			
Lower bound	0.918	0.933	0.867
Upper bound	1.120	1.074	0.974

Note: Asterisks (*) denote significant differences from unity at 0.05.

[8] The proportion of establishments hiring less than ten persons in 2007 was 90 percent (17 510 out of 19 493).

Table 5: Efficiency Change, 2005-2008

	2005-06	2006-07	2007-08
Wholesale	1.014	1.052	0.887
Retail	0.922	0.965	0.962
Transport and Storage services	1.000	1.000	1.000
Accommodation Services	1.000	1.000	1.000
Food and Beverages Services	0.927	0.917	0.982
Information and Communications Services	0.948	0.935	1.076
Financial and Insurance Services	1.000	1.000	1.000
Real Estate and Business Services	0.987	0.929	1.028
Community, Social and Personal Services	0.975	0.939	1.053
Confidence Intervals			
Lower bound	0.922	0.917	0.887
Upper bound	1.014	1.052	1.076

Note: Asterisks (*) denote significant differences from unity at 0.05.

Table 6: Technical Change, 2005-2008

	2005-06	2006-07	2007-08
Wholesale	0.998	0.983	0.977
Retail	0.995	0.984	1.012
Transport and Storage services	0.997	1.011	0.947
Accommodation Services	1.041	1.056	0.928
Food and Beverages Services	1.029	1.017	0.930
Information and Communications Services	1.031	1.029	0.904
Financial and Insurance Services	1.120	1.074	0.953
Real Estate and Business Services	1.054	1.027	0.946
Community, Social and Personal Services	0.992	1.025	0.906
Confidence Intervals			
Lower bound	0.992	0.983	0.904
Upper bound	1.120	1.074	1.012

Note: Asterisks (*) denote significant differences from unity at 0.05.

Sensitivity Test

Three sensitivity tests were conducted; the first was done by taking away the 'Financial and Business Services' sector to see if the results remained robust (i.e., the rankings remain more or less in the same order). Table 7 shows no change in the rankings compared to Table 3, thus implying that the results are robust.

Table 7: Sensitivity Test 1 -Ranked TFP scores of 8 service sectors, 2005-2008

	TFP	Technical Change	Efficiency Change	Pure Technical Efficiency	Scale Efficiency	Rank
Wholesale	0.967	0.968	0.999	1.000	0.999	5
Retail	0.947	0.997	0.949	0.960	0.989	7
Transport and Storage Services	0.982	0.982	1.000	1.000	1.000	3
Accommodation Services	1.007	1.007	1.000	1.000	1.000	1
Food and Beverages Services	0.933	0.991	0.942	0.993	0.948	8
Information and Communications Services	0.969	0.964	1.005	1.004	1.002	4
Real Estate and Business Services	0.997	1.000	0.997	1.000	0.997	2
Community, Social and Personal Services	0.961	0.973	0.988	1.000	0.988	6
Mean	0.970	0.985	0.985	0.995	0.990	

A second sensitivity test was done by removing the quality of service input 'remuneration' to test if this would have an impact on the results. Detailed results in Table 8 shows that 'Financial and Business Services' and 'Accommodation services' still hold the top two spots. The last spot is still held by 'Food and Beverages Services'. Except for 'Retail', most sectors retained similar rankings as those found in Table 3. The exclusion of input 'Remuneration' has raised the ranking of 'Retail' from eighth to fifth mainly from TE and E, which indicates that failure to include 'Remuneration' can over-estimate 'Retail' performance. The above sensitivity analysis thus shows some unstable ranking, implying that input 'remuneration' needs to be included as it plays a significant role especially in service sectors. Kong and Tongzon (2006) had similar unstable rankings in their sensitivity tests, which suggest that their input 'wages' as a quality measure needs to be taken into account.

Table 8: Sensitivity Test 2 -Ranked TFP scores of 9 service sectors (without 'Remuneration'), 2005-2008

	TFP	Technical Change (T)	Efficiency Change (E)	Pure Technical Efficiency (PTE)	Scale Efficiency (SE)	Rank
Wholesale	0.989	1.007	0.982	1.000	0.982	4
Retail	0.976	1.010	0.967	0.956	1.011	5
Transport and Storage Services	0.976	0.976	1.000	1.000	1.000	6
Accommodation Services	1.007	1.007	1.000	1.000	1.000	2
Food and Beverages Services	0.944	0.974	0.969	1.030	0.940	9
Information and Communications Services	0.971	0.986	0.984	1.004	0.980	7
Financial and Insurance Services	1.047	1.047	1.000	1.000	1.000	1
Real Estate and Business Services	0.994	1.013	0.981	1.000	0.981	3
Community, Social and Personal Services	0.961	0.973	0.988	1.000	0.988	8
Mean	0.989	1.007	0.982	1.000	0.982	

The third sensitivity test was done by changing the time-period to 2003 to 2007 to determine if changes in TFP were due to changes either in TE or E. The results in Table 9 showed that while mean TFP was 0.3 percent, this was attributed to TE (2.0 percent) and not E (-1.6 percent). There was hardly any growth in efficiency for most sectors except 'Wholesale', thus suggesting that TFP growth was mainly attributed to factor accumulation, which demonstrates consistency with our initial findings.

Table 9: Sensitivity Test 3 -Ranked TFP scores of 9 service sectors, 2003-2007

	TFP	Technical Change (T)	Efficiency Change (E)	Pure Technical Efficiency (PTE)	Scale Efficiency (SE)	Rank
Wholesale	1.046	1.010	1.035	1.000	1.035	3
Retail	0.963	1.002	0.960	0.952	1.008	8
Transport and Storage Services	1.020	1.020	1.000	1.000	1.000	4
Accommodation Services	1.073	1.073	1.000	1.000	1.000	1
Food and Beverages Services	0.962	1.016	0.947	0.959	0.988	9
Information and Communications Services	0.975	0.998	0.977	0.990	0.987	6
Financial and Insurance Services	1.054	1.054	1.000	1.000	1.000	2
Real Estate and Business Services	0.967	1.008	0.960	1.000	0.960	7
Community, Social and Personal Services	0.978	0.999	0.978	1.000	0.978	5
Mean	1.003	1.020	0.984	0.989	0.995	

5. Concluding Remarks

This paper analysed productivity growth in Singapore's Services sector for the period 2005 to 2008. Using the Malmquist productivity index, TFP growth was decomposed into technical change and efficiency change. Two outcomes were revealed in our findings: first, the results support the findings of ESC 2010 that productivity of Services sector had been digressing in recent years; and second, the results showed that any productivity was attributed to technical change with no improvements in efficiency change even for sectors which posted TFP growth. This result further suggests that any TFP growth was mainly due to factor accumulation. Krugman (1994) found that Singapore's growth was driven by factor accumulation and not sustainable in the long run. In addition, the plans and initiatives of PSB and SPRING may have had some success in the short-term but not in the long-term. Singapore now needs to adopt a best-practice approach through appropriate resource allocation and optimising its scale of operations in order to achieve sustainable TFP growth.

Whilst the study has provided interesting results and concerns for Singapore, it should be noted that one of the main limitations of the current study was the use of a small sample size. A large sample size would have provided more robust results, especially when using the Malmquist productivity index model. This outcome may be improved by using disaggregated data drawn from associated publications. For example, the publication *Economic Surveys Series: Transport and Storage Services* provides detailed statistics of 'Air Transport', 'Land Transport', 'Water Transport' and 'Storage Services'. Nonetheless, the current findings still provide some useful information that identifies the weak and strong services, which in turn allows the implementation of appropriate government policies to help address the laggard services to raise their productivity and efficiency levels. The study also included a brief statistical inference using a bootstrap approach as well as sensitivity analysis to see if the results generated by the Malmquist indices were robust. The bootstrap approach of Simar and Wilson (1999) showed that the results were statistically insignificant thus concluding that the 'null hypothesis' of insignificant productivity change cannot be rejected. The three sensitivity

tests showed that the results were robust and require the inclusion of the quality input ‘remuneration’. Furthermore, the sensitivity analysis also implied that changing the time-period may have changed some of the rankings, but in general still showed that any TFP growth was attributed to technical change and not efficiency change.

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