Are Private Providers more Productive and Efficient than Public Providers of International Education? Evidence from New Zealand

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Abstract

This study has investigated the productivity growth and efficiency of private and public providers of international education in New Zealand. It has used secondary data to calculate the DEA-based Malmquist productivity index for measuring Total Factor Productivity (TFP)-growth and efficiency of both public and private providers of international education during 1999-2010. The study has found that private providers experienced a larger TFP-growth than that of public providers during 1999-2004. However, they experienced a sharp decline in TFP-growth since 2005 through to 2010 and experienced a much smaller TFP-growth than that of public providers during this period. Conversely, public providers experienced a positive TFP-growth during 1999-2004 but they experienced a negative TFP-growth since 2005 through to 2010. Considering efficiency, both private and public providers experienced almost a constant Technical Efficiency Change (TEC) having a same level of efficiency of one. Both private and public providers exhibited a constant return to scale during 1999-2010. This study argues that on an average, private providers are more productive than public providers of international education. However, they are not more efficient than public providers as both types of providers exhibited a constant return to scale during 1999-2010. This study also argues that TFP-growth of New Zealand's international education was determined by Technological Change (TC), not by TEC during this period.

Key words: International education, total factor productivity growth, productivity, efficiency, private and public education providers, New Zealand

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Introduction

In the 1980s, the re-emergence of neo-classical orthodoxy as a new development paradigm through the global economic integration influenced many countries around the world including New Zealand for opening up the domestic education to international students. There has been a substantial increase in demand for international education in New Zealand since late 1980s (Abbott, 2004: 2; 2005: 2; Ministry of Education, 2001a: 17). New Zealand's private education sector developed as a market response to a situation where large numbers of international students were willing to study in New Zealand but public education providers had not been capable to accommodate the influx of international students (Abbott, 2004: 1).

Prior to 1989, only public providers - the government owned polytechnics, colleges of education and universities were allowed to enrol international students as per the provision of tertiary education in New Zealand (Abbott, 2004: 1). In order to cope with the growing demand for international education, the government undertook initiatives to develop the private education sector with a view to creating a competitive environment between private and public providers of international education. As a result of these government's initiatives, New Zealand's international education sector went through a series of reforms for internationalisation of education. The government enacted the *Education Act 1989* for allowing private providers to enrol foreign students (Abbott, 2004: 2; Collins, 2010: 944).

As a result of the *Education Act 1989*, the competitive environment between private and public providers of tertiary education in New Zealand intensified throughout the 1990s. By the early 1990s, both private and public providers became equally dominant and competitive to capture a larger share of international students. Private and public providers captured the enrolment of international student by 48 and 52 percent respectively, on an average per year during 1999-2010 (Ministry of Education, 2001b, 2009, 2010). Therefore, both private and public providers became important in New Zealand's international education sector in terms of enrolment of foreign students and sector's contribution to gross domestic product (GDP) of the economy by an average of

over 2 billion dollars per year (Abbott, 2004: 2; Ali and Talukder, 2006: 2; Education New Zealand and Ministry of Education, 2008: 1). The competitiveness of both types of provider lies with their productivity and efficiency.

Therefore, the objective of this study is to investigate TFP-growth of international education in New Zealand with a view to presenting a comparative analysis of productivity and efficiency between private and public providers of international education. This study has applied the DEA-based Malmquist productivity index to achieve its objective. It has attempted to contribute to the general discussion and debate on the analysis of productivity growth and efficiency in the context of New Zealand's international education.

Literature Review and Theoretical Context

International Education in New Zealand

Many studies have attempted to shed light on New Zealand's international education sector. These studies on New Zealand's international education may be divided into two broad categories by researchers: Ministry of Education, and other researchers. Similarly, such studies may be divided into three sub-categories by the nature of their investigation: trends of international students, impact of international education, and policy and strategy formulation.

Some major studies related to trends of international students in New Zealand include: Abbott (2004, 2005); Ali and Talukder (2006); Asia 2000 Foundation (2003); McInnis, Peacock *et al* (2006); Ministry of Education (2001a, 2001b, 2002, 2005, 2007b, 2008b, 2009, 2010). Some major studies related to the impact of international education on New Zealand economy include: Collins (2010); Education New Zealand and Ministry of Education (2008); Ministry of Education (2006a, 2006b, 2008a, 2008c); Ward (2001); and Ward and Masgoret (2004). Some major studies related to policy and strategy formulation include: Abbott (2005); Ministry of Education (2007a, 2008c).

Amongst the above studies only Abbott (2005) analysed the characteristics of private and public providers of international education in New Zealand. He argued that the role of

both private and public providers of international education increased equally since the early 1990s but the government restricted opportunities for the private sector to expand – notably: private universities were prohibited. This prohibition by the government is related to preserving the dominance of public higher education to compete with private education providers. He also argued that private higher education in New Zealand got distinct characteristics which were different from public providers. Private higher education was highly specialised in small areas of discipline such as business and information technology rather than the broad areas of conventional academic standing or in the mass provision of higher education. Furthermore, private higher education had a high concentration at the diploma and certificate level rather than at the degree and post-graduate degree level.

The common downside of these studies is that they did not analyse and cover the context of a comparative study on productivity and efficiency of private and public providers of New Zealand's international education leaving a significant gap in the literature. This study has attempted to address this gap by investigating TFP-growth and efficiency of private and public providers of international education with a view to analysing and comparing productivity and efficiency of private and public providers of international education.

Total Factor Productivity (TFP) and Efficiency

Various growth theories (such as the neoclassical growth models, new endogenous growth theories, and evolutionary models of economic change) identified technological progress as the key source of productivity growth (Gore, 2007: 31). However, the way in which technological progress was understood to take place and how it affected productivity-growth differed among them (Gore, 2007: 42). Total factor productivity that was derived from technological progress was the main source of economic growth (Krugman, 2000: 52). Despite of extensive empirical research generated by growth theories, there was remarkably little consensus on empirical results because of theoretical ambiguity, conceptual complexity, differences in model specification, choice of

variables, methodology, and measurement shortcomings (Durlauf, Kourtellos *et al.*, 2008: 329).

TFP-growth measures the proportion of output not explained by the amount of inputs. It is generally calculated as a residual (Englander, 1988: 6; Hisali and Yawe, 2011: 14). Solow (1957) introduced pioneering work on the measurement of productivity growth and technical progress which was associated with a production function/cost function/profit function. Since then, measurement of TFP-growth became an important objective of researchers to support development policy analysis (Caves, Christensen *et al.*, 1982: 1393; Chang and Hu, 2010: 3263; Windle and Dresner, 1992: 435).

Thus, economists devoted considerable resources to TFP-growth measurement, both in theory and practice (Färe and Grosskopf, 1992: 158). They developed many techniques that could be used for such measurement. These techniques may include index numbers such as Malmquist productivity index (Caves, Christensen, *et al.*, 1982: 1394; Färe and Grosskopf, 1992: 158), Solow's residual (Raa and Shestwova, 2006: 3; Solow, 1957: 312), Törnqvist productivity index (Caves, Christensen, *et al.*, 1982: 1394) , and Fisher Ideal Index (Färe and Grosskopf, 1992: 158); stochastic production frontier estimation techniques (Sharma, Sylwester *et al.*, 2007: 218); Monte Carlo simulation techniques (Slade, 1986: 76); translog production function (Chang and Hu, 2010: 3263); growth accounting matrix (Griliches, 1996: 1324); and Durenberger productivity indicator (Barros, Guironnet *et al.*, 2011: 642).

Economists use both mathematical and econometric models to measure TFP-growth. There are four main approaches to the measurement of TFP-growth by using mathematical models. They are (a) Solow's residual analysis, (b) the Index Number Approach, (c) Input-Output Analysis, and (d) Data Envelopment Analysis (DEA) (Raa and Shestwova, 2006: 1).

Malmquist productivity index is a popular and widely used index number technique because it is simple to measure, easy to understand, reliable in results, provides high accuracy, has minimum restrictions for model specification, and is easy to decompose into two major components: technical efficiency change and technological change – the

main sources of TFP-growth. In addition, it calculates efficiency and benchmark scores of firms or decision making units (DMU). Similarly, the DEA method is a commonly used approach to the measurement of TFP-growth. The main advantage of using the DEA method is that it avoids model miss-specification (Cook and Zhu, 2005: 1). This is a scale-neutral method using the measurement of inputs and outputs. (Chang and Hu, 2010: 3263). This method is based on the linear programming techniques.

This study has used the DEA method to calculate the Malmquist productivity index (TFP) with a view to identifying sources of productivity growth and efficiency of private and public providers of New Zealand's international education. The advantage of DEA based Malmquist productivity index is that it automatically calculates the efficiency of factors or inputs. The output-oriented efficiency of factors measures the maximum output from a given input. Similarly, input-oriented efficiency measures the use of minimum input to produce a given output. It is related to returns to scale such as increasing, constant and decreasing return to scale.

Methodology (Research Design and Data)

DEA Approach to Malmquist Productivity Index

The DEA-based Malmquist productivity index measures the changes in TFP-growth over time. It can be decomposed into two main components- technical efficiency change (TE) and technological change (TC) or frontier shift. The TFP index represents the multiplicative impacts of these two components. The TE measures the sector's ability to produce the maximum possible output (GDP) from a given set of inputs and production technology. On the other hand the TC measures the frontier shift - the shift in production possibility frontier (PPF). It represents technological progress (outward shift of PPF) or contraction (inward shift of PPF) or no change. Thus TFP-growth level is determined by how efficiently and intensely the inputs are utilised in international education as well as by the level of technological change. A value of TFP, TE and TC greater than one represents progress in total factor productivity growth, technical efficiency change and technological change respectively vice versa. Similarly, a unitary value of any component of them (TFP, TE and TC) implies no change in that respective component.

This study applied DEA method to computing the Malmquist productivity index for measuring TFP-growth of New Zealand's export education. It has used a methodology following the pioneering works of Färe and Grosskopf (1992) and Grosskopf, Norris *et al. (*1994*)* as below:

The production possibility set-

$S^t = \{(x^t, y^t): x^t \; can \; produce \; y^t\}$,

where time-period t = 1, 2 ...T. The technology is assumed to have standard properties such as convexity. The production (output) sets are defined in terms of S^tas:

$P_t(x) = \{y^t: (x^t, y^t) \in S^t\}$.

The successive productions sets are essentially independent from each other. However, there is a certain form of dependence between sequential production sets across time. This dependence is based on the assumption that production units can always produce same amount of outputs with given same amount of inputs as they have done before in the production processes. Thus, the construction of the latest set requires information on inputs and outputs of any previous period for measuring productivity performance.

In order to calculate the Malmquist productivity index by using sequential DEA approach, the output distance function for each period t can be written as follows:

$$d^t\,(x^t, y^t) = min\left\{\lambda: \left(\frac{y^t}{\lambda}\right) \in P_t^{seq}(x)\right\};$$

where superscript P_t^{seq} denotes sequential output set. When λ is minimised, then y^t/λ is maximised. Therefore, this distance function measures the maximum possible output with a given input vector x^t and technology under period t. Thus, the Malmquist productivity index can be defined as (Färe and Grosskopf, 1992; Färe, Grosskopf, *et al.*, 1994):

$$M(x^t, y^t, x^s, y^s) = \frac{d^t(x^t, y^s)}{d^s(x^s, y^s)} \times \left[\frac{d^s(x^t, y^t)}{d^t(x^t, y^t)} \times \frac{d^t(x^s, y^s)}{d^s(x^s, y^s}\right]^{1/2};$$

where, in the right hand side of the equation, the ratio outside the brackets measures the change in technical efficiency (TEC) between two periods (years), *t* and *s*. The geometric mean of the two ratios inside the square brackets captures the shift in technology (TC)

between two periods. In order to calculate output-oriented Malmquist productivity index under the assumption of constant return to scale (CRS) technology four distance functions are required to be calculated as follows:

$$\left[d_c^{t+i}(x_{\acute{k}}^{t+j}, y_{\acute{k}}^{t+j})\right]^{-1} = \max_{\theta, z_k^s} \theta^{\acute{k}},$$

subject to

$$-\theta^{\acute{k}} y_{k,m}^{t+j} + \sum_{s=1}^{t+i} \sum_{k=1}^{K} z_k^s y_{k,m}^s \geq 0, \quad m = 1, \ldots\ldots, M$$

$$x_{\acute{k},n}^{t+j} - \sum_{s=1}^{t+i} \sum_{k=1}^{K} z_k^s x_{k,n}^s \geq 0, \quad n = 1, \ldots\ldots, N$$

$$z_k^s \geq 0, \quad k = 1, \ldots\ldots, K, and\ s = 1, \ldots\ldots, T,$$

where

$$\left[d_c^t(x_{\acute{k}}^t, y_{\acute{k}}^t)\right]^{-1} \quad is\ calculated\ with\ (i,j) = (0,0);$$

$$\left[d_c^s(x_{\acute{k}}^s, y_{\acute{k}}^s)\right]^{-1} is\ calculated\ with\ (i,j) = (1,1);$$

$$\left[d_c^t(x_{\acute{k}}^s, y_{\acute{k}}^s)\right]^{-1} \quad is\ calculated\ with\ (i,j) = (0,1);$$

$$\left[d_c^s(x_{\acute{k}}^t, y_{\acute{k}}^t)\right]^{-1} \quad is\ calculated\ with\ (i,j) = (1,0);$$

where subscript c denotes the CRS benchmark technology and calculates output-oriented efficiency. The symbols K, N, M and T represent total number of firms, inputs, outputs and periods respectively. The symbol θ denotes a scalar of the proportional expansion in output for a given input vector and z_k^s is an intensity variable indicating at what intensity production unit k may be employed in production.

Data Sources

The study has used data from secondary sources such as New Zealand's Ministry of Education and Statistics New Zealand. It has used data for student numbers, tuition fees, export levies, and education providers from the database of the Ministry of Education. The contribution of international education to GDP (output) is calculated on the basis of approximation as per total number of international students following the estimation done by Education New Zealand and Ministry of Education (2008). Similarly, labour (total

number of employees) is calculated proportionately based on the ratio of international students to total number of students in New Zealand. The value of capital (capital stock) is calculated from the National Accounts database of Statistics New Zealand using the same proportional method as used in the case of labour.

Descriptive Statistics of Data

The descriptive statistics of data - the mean, standard deviation and skewness is presented in Table 1. The descriptive statistics of data suggest that both private and public providers of international education in New Zealand have very similar characteristics of data considering the following factors: total number of students, labour, capital, GDP, tuition fees and levies. The values of standard deviations for all variables are large suggesting that data are dispersed away from the mean. The skewness values for all variables with public providers are negative indicating that the distribution is left skewed or a large proportion of observations is distributed on the right side of the mean suggesting that mean is smaller than median and the median is smaller than the mode. On the other hand, these values for all variables with private providers are positive except the case of capital implying that the distribution of data is right skewed or a large proportion of data are distributed on the left side of the mean. It also indicates that there have been extreme values to the right side of the mean implying that the mean is greater than the median and the median is greater than the mode. The descriptive statistics of this study suggests that the distribution of data is asymmetric – a deviation from a normal distribution.

Table 1: Descriptive statistics: 1999-2010

	Mean		**Std Deviation**		**Skewness**	
	Private	**Public**	**Private**	**Public**	**Private**	**Public**
Total student	46352.67	43012.58	16259.34	13333.34	0.134	-1.267
Labour (total staff)	3002.08	2780.83	10.66.75	851.89	0.134	-1.267
Capital ($m)	22.67	21.36	7.98	7.99	-0.88	-0.86
Contribution to GDP ($m)	948.08	879.83	332.60	272.68	0.136	-1.26
Tuition fees and levy ($m)	226.87	390.31	131.25	159.12	2.00	-0.86

Source: Author's calculation

Results Discussion and Analysis

Comparison of Total Factor Productivity: Private versus Public

As shown in Table 2, both private and public providers of international education in New Zealand experienced a high TFP-growth of international education between 1999 and 2004 and a low TFP-growth between 2005 and 2010. This study suggests that both private and public providers experience a high TFP-growth of international education in the early years of influx of international education in New Zealand. TFP-growth has stated to slow down since 2005 through to 2010.

Table 2: TFP-growth in NZ international education by providers and sources: 1999-2010

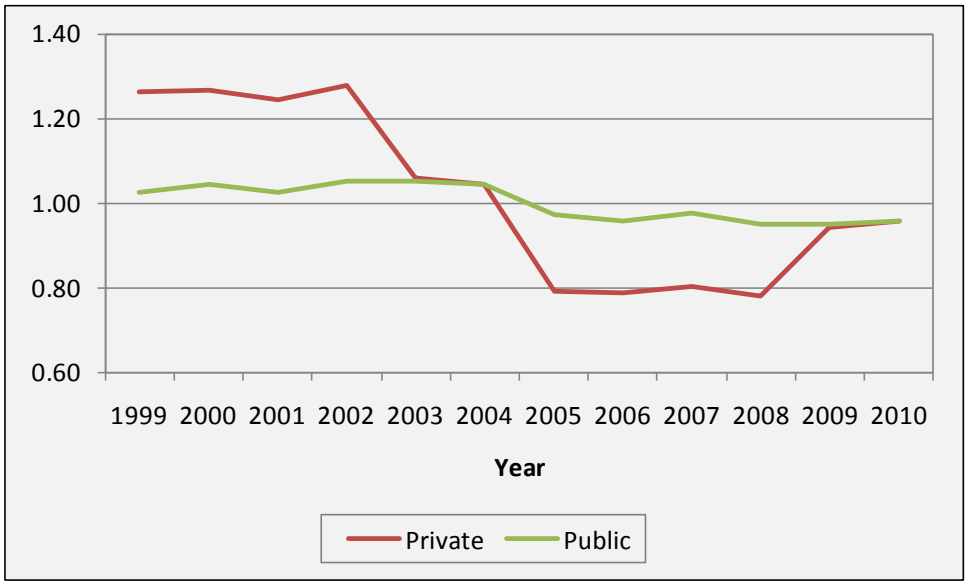
Year	Malmquist Index (TFP)		Technical Efficiency Change (TEC)		Technological Change (TC)	
	Private	Public	Private	Public	Private	Public
1999	1.262	1.027	1.0000	1.0000	1.262	1.027
2000	1.269	1.045	1.0000	1.0000	1.269	1.045
2001	1.244	1.024	1.0000	1.0000	1.244	1.024
2002	1.279	1.053	1.0000	1.0000	1.279	1.053
2003	1.061	1.051	1.0004	1.0000	1.061	1.051
2004	1.044	1.044	1.0000	1.0000	1.044	1.044
2005	0.792	0.974	1.0000	1.0000	0.792	0.974
2006	0.788	0.957	1.0000	1.0000	0.788	0.957
2007	0.804	0.976	1.0000	1.0000	0.804	0.976
2008	0.782	0.950	1.0000	1.0000	0.782	0.950
2009	0.943	0.951	0.9996	1.0000	0.943	0.951
2010	0.958	0.958	1.0000	1.0000	0.958	0.958
Average (1999-2010)	1.01883	1.00083	1.00000	1.00000	1.01883	1.00083

Source: Author's calculation

Considering the total period between 1999 and 2010, both private and public providers experienced, on an average, a declining trend in TFP-growth that is clearly evident from Figure 1. The values of TFP were greater than one over the period from 1999 to 2004 suggesting that the TFP-growth of international education improved during this period. Conversely, the values of TFP-growth were less than one for the period from 2005 through to 2010 implying that TFP-growth declined during this period. Private providers

experienced a much higher TFP-growth than that of public providers during 1999-2004. On the contrary, they experienced a much lower TFP-growth than that of public providers of international education during 2005-2010. As shown in Table 2, private provider experienced a higher TFP-growth by 1.01883 per year for the combined periods 1999 to 2010 than that of public providers that experienced an average TFP-growth by 1.00083 per year during the same period. This study suggests that, on an average, private providers were more productive than public providers of New Zealand's international education during 1999-2010.

Figure 1: TFP-growth of international education by providers: 1999-2010



Source: Author's calculation

As mentioned earlier, the Malmquist productivity index (TFP) is decomposed into TEC and TC or frontier shift. This is a multiplicative effect of TEC and TC. Interestingly, the values of TEC were almost equal to one for each year during 1999-2010 implying that there was a little change in TEC over that period. It is evident from Figure 2 that both private and public providers of international education experienced almost the same pattern of TEC over the period 1999-2010. Therefore, TECs for both private and public providers coincide with each other and are almost constant to one showing almost parallel lines to the horizontal axis during that period. The average TEC for both private

and public providers of international education was 1.0000 indicating a constant return to scale during 1999-2010.

Figure 2: Technical efficiency change (TEC) by providers: 1999-2010

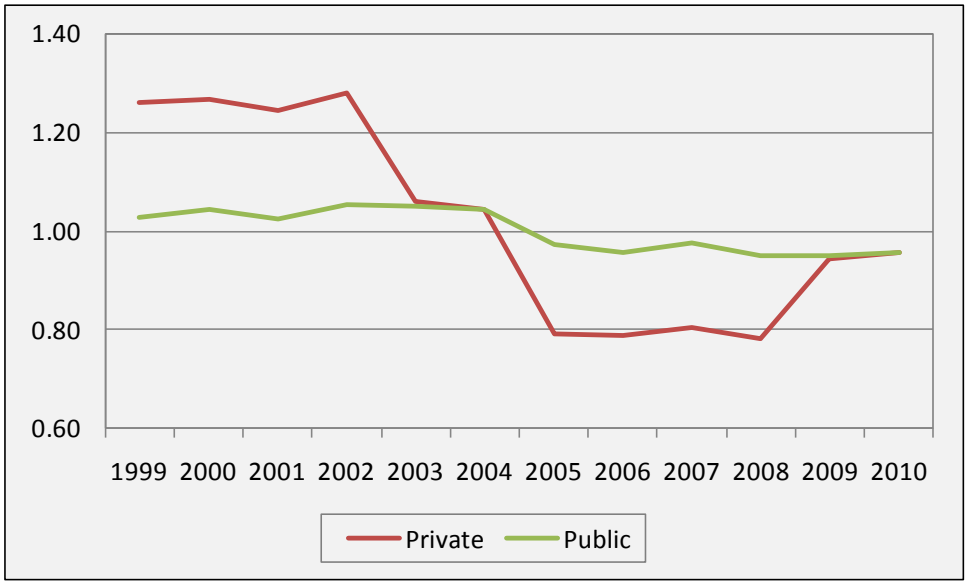
Source: Author's calculation

As the values of TEC for both private and public providers of international education were almost constant (one) during 1999-2010, therefore, TFP-growth may be attributed mainly to the frontier shift or TC during that period as shown in Figure 3. This analysis suggests that TFP-growth in international education during 1999-2010 was derived from technological change, not from technical efficiency change. Therefore, the values of TFP-growth equalled to the corresponding values of TC for each year for both cases of private and public providers during that period. Thus the TC curves for both private and public providers of international education are similar to their corresponding TFP curves (as shown in Figure 1) during 1999-2010.

The values of TC for both private and public providers were greater than one between 1999 and 2004 suggesting that New Zealand's international education sector experienced technological progress during this period. However, the values of TC for both private and public providers were less than one between 2005 and 2010 indicating either

technological contraction or non-improvement during this period. TFP-growth for both private and public providers moved along with TC throughout the entire period from 1999-2010. The TFP-growth analysis suggests that technological contraction or non-improvement was mostly responsible for a declining trend of TFP-growth during 1999-2010.

Figure 3: Technological change by private and public providers: 1999-2010



Source: Author's calculation

Comparison of Efficiency: Private versus Public Providers

The Malmquist productivity index has provided not only TFP-grwoth driven from TEC and TC but also efficiency and benchmark scores for private and public providers of international education. This study has used the efficiency and benchmark scores for a comparative analysis and measuring efficiency between private and public providers of international education in New Zealand. The efficiency and benchmark scores are presented in Table 3. It is clearly evident that both private and public providers of international education exhibited constant return to scale during 1999-2010. This fact implies that 1 percent increase in input will raise output by 1 percent (same proprotion). These results indicate that the marginal productivity of input (labour and capital) of international education sector in New Zealand is equal to zero. This study argues that

private providers were not more efficient than public providers of international education in New Zealand during 1999-2010 as both types of education providers were constrained by technological contraction or non-improvement. Therefore, an expansion of education service by both types of providers will likely to decrease marginal productivity of factors such as labour and capital.

Table 3: Output-oriented efficiey and benchmark scores: private versus public providers, 1999-2010

	Private Providers			Public Providers		
Year	**Output-Oriented Efficiency**	**Benchmarks (Σλ)**	**Returns to Scale**	**Output-Oriented Efficiency**	**Benchmarks (Σλ)**	**Returns to Scale**
1999	1.00000	0.484	Constant	1.00000	0.290	Constant
2000	1.00000	1.000	Constant	1.00000	0.434	Constant
2001	1.00000	1.871	Constant	1.00000	0.577	Constant
2002	1.00000	1.000	Constant	1.00000	1.000	Constant
2003	1.00000	1.000	Constant	1.00000	1.000	Constant
2004	1.00000	1.000	Constant	1.00000	1.000	Constant
2005	1.00000	1.000	Constant	1.00000	1.000	Constant
2006	1.00000	1.067	Constant	1.00000	0.934	Constant
2007	1.00000	1.000	Constant	1.00000	0.880	Constant
2008	1.00000	1.020	Constant	1.00000	0.889	Constant
2009	0.99958	1.080	Decreasing	1.00000	0.852	Constant
2010	1.00000	1.000	Constant	1.00000	0.903	Constant

Source: Author's calculation

Conclusions

The findings of this study suggest that both private and public providers of international education experienced a declining trend in TFP-growth mainly caused by technological contraction or non-improvement during 1999-2010. Although, the Malmquist productivity index (TFP) is determined by both TEC and TC, TFP-growth mostly moved along with TC, not with TEC indicating that TFP-growth was mostly influenced by TC because the values of TEC were constant for both cases of private and public providers of international education during this period. Private providers, on an average, exhibited a larger TFP-growth than that of public providers of international education implying that

private providers were more productive than public providers during this period. On the other hand, private providers were not more efficient than public providers because both types of education providers exhibited constant return to scale during this period. However, both private and public providers of international education experienced a declining trend in TFP-growth constrained by technological contraction or non-improvement. The study suggests that the government should formulate policies to increase efficiency of education providers and to improve productivity of factors (inputs) and TFP-growth. These policies may include: policies for increasing investment in research and development (R&D) for enhancing innovation and technological progress; and policies to improve productivity of labour by increasing skills through human resource development programmes such as training and diffusion of improved technology. This study argues that the formulation and implementation of these policies would increase efficiency of education providers and improve TFP-growth and productivity of factors that would contribute to improving economic performance of New Zealand's international education sector in the future.

References:

Abbott, M. 2004. *Commercial Risks and Opportunities in the New Zealand Tertiary Education Sector*. Working Paper No. 3, AIS St Helens.

Abbott, M. 2005. *Private Higher Education Penetration into a Mature Education Market: The New Zealand Experience*. PROPHE Working Paper Series, WP No. 6 July 2005.

Ali, E., and Talukder, D. 2006. *The Transportation Problems Faced by International Students in Auckland*. Centre for Research in Internatioal Education, Working Paper no. 10, AIS, Auckland: AIS St Helens.

Asia 2000 Foundation. 2003. *The Export Education Industry: Challenges for New Zealand*. An Asia 2000 Occasional Paper, Asia 2000 Foundation, New Zealand, 8 April 2003.

Barros, C. P., Guironnet, J., and Peypoch, N. 2011. Productivity Growth and Biased Technical Change in French Higher Education. *Economic Modelling, 28*(1-2): 641-646.

Caves, D. W., Christensen, L. R., and Diewert, W. E. 1982. The Economic Theory of Index Numbers and the Measurement of Input, Output and Productivity. *Econometrica, 50*(6): 1393-1414.

Chang, T., and Hu, J. 2010. Total-Factor Energy Productivity Growth, Technical Progress, and Efficiency Change: An Empirical Study of China. *Applied Energy, 87*(10): 3262-3270.

Collins, F. L. 2010. International Students as Urban Agents: International Education and Urban Transformation in Auckland, New Zealand. *Geoforum, 41*(6): 940-950.

Cook, W. D., and Zhu, J. 2005. *Modeling Performance Measurement: Application and Implementation of Issues in Dea*. New York: Springer Science+Business Media, Inc.

Durlauf, S. N., Kourtellos, A., and Tan, C. M. 2008. Are Any Growth Theories Robust? *The Economic Journal, 118*(527): 329-346.

Education New Zealand, and Ministry of Education. 2008. *The Economic Impact of Export Education*. A report jointly commissioned by Education New Zealand and Ministry of Education.

Englander, A. S. 1988. *Test of Total Factor Productivity Measurement*. OECD Economic Development Working Paper No. 54.

Färe, R., and Grosskopf, S. 1992. Malmquist Indexes and Fisher Ideal Indexes. *The Economic Journal, 102*(410, 1992): 158-160.

Färe, R., Grosskopf, S., Norris, M., and Zhang, Z. 1994. Productivity Growth, Technical Progress, and Efficiency Change in Industrialised Countries. *The American Economic Review, 84*(1): 66-83.

Gore, C. 2007. Which Growth Theory Is Good for the Poor. *The European Journal of Development Research, 19*(1): 30-48.

Griliches, Z. 1996. The Discivery of Residual: A Historic Note. *Journal of Economic Literature, 34*(3): 1324-1330.

Hisali, E., and Yawe, B. 2011. Total Factor Productivity Growth in Uganda's Telecommunications Industry. *Telecommunications Policy, 35*(1): 12-19.

Krugman, P. R. 2000. Technology, Trade and Factor Price. *Journal of International Economics, 50*(2000): 51-71.

McInnis, C., Peacock, R., and Catherwood, V. 2006. *Internationalisation in New Zealand Tertiary Education Organisations*. International Division, Ministry of Education, New Zealand

Ministry of Education. 2001a. *Export Education in New Zealand: A Strategic Approach to Developing the Sector*. Ministry of Education, New Zealand.

Ministry of Education. 2001b. *Foreign Fee-Paying Students in New Zealand: Trends*. Strategic Information and Resourcing Division, Ministry of Education, New Zealand.

Ministry of Education. 2002. *Foreign Fee-Paying Student Statistics to 2001*. International Policy and Development Unit, Strategic Information and Resourcing Division, Ministry of Education, New Zealand.

Ministry of Education. 2005. *The New Zealand International Education Sector: Trend from 1999 to 2004*. International Division and Data Management and Analysis, Ministry of Education, New Zealand.

Ministry of Education. 2006a. *The Economic Impact of Foreign Fee-Paying Students*. Report prepared for Ministry of Education by Infometrics, New Zealand.

Ministry of Education. 2006b. *Tracking the Influence of Currency Values: A Research Paper for Sector Discussion*. International Division, Ministry of Education.

Ministry of Education. 2007a. *The International Education Agenda: An Strategy for 2007–2012*. Wellington: Ministry of Education, International Division, New Zealand.

Ministry of Education. 2007b. *International Enrolments in New Zealand: 2000 – 2006*. International Division, Ministry of Education, New Zealand

Ministry of Education. 2008a. *The Experiences of International Students in New Zealand: Report on the Results of the National Survey 2007*. Ministry of Education, New Zealand.

Ministry of Education. 2008b. *International Student Enrolments in New Zealand: 2001 – 2007*. International Division, Ministry of Education, New Zealand.

Ministry of Education. 2008c. *Review of the International Student Levy*. Ministry of Education, New Zealand.

Ministry of Education. 2009. *International Student Enrolments in New Zealand : 2002-2008*. International Division, Ministry of Education, New Zealand.

Ministry of Education. 2010. *International Student Enrolments in New Zealand: 2003 – 2009*. Ministry of Education, New Zealand.

Raa, T., and Shestwova, V. 2006. *Alternative Measures of Total Factor Productivity Growth*. Center Discussion Paper No. 2006-54.

Sharma, S. C., Sylwester, K., and Margono, H. 2007. Decomposition of Total Factor Productivity in Us States. *The Quarterly Review of Economomics and Finance, 47*(2007): 215-243.

Slade, M. E. 1986. Total-Factor-Productivity Measurement When Equilibrium Is Temporary: A Monte Carlo Assessment. *Journal of Econometrics, 33*(1986): 75-95.

Solow, R. 1957. Technical Change and the Aggregate Production Function. *The Review of Economics and Statistics, 39*(3): 312-320.

Ward, C. 2001. *The Impact of International Students on Domestic Students and Host Institutions*. Ministry of Education, New Zealand.

Ward, C., and Masgoret, A. 2004. *The Experiences of International Students in New Zealand: Report on the Results of the National Survey*. Prepared for the Ministry of Education, New Zealand.

Windle, R. J., and Dresner, M. E. 1992. Partial Productivity Measures and Total Factor Productivity in the Air Transport Industry: Limitations and Uses. *Transportation Research Part A: Policy and Practice, 26*(6): 435-445.