The cost efficiency of New Zealand's polytechnics

Malcolm Abbott and Hristos Doucouliagos

Abstract

In New Zealand the most important institutions that are responsible for the delivery of vocational education and training programs are the government owned and operated tertiary education institutions known as polytechnics.[1] The New Zealand polytechnics deliver programs at the certificate, diploma and degree level. During the course of the 1990s, expansion of participation in vocational education and training was a major priority on the part of the New Zealand Government (OECD 2002). In order to enable this to occur without placing too great a financial burden on the government and taxpayers, the polytechnics have become more dependent upon non-government sources of income (both student fees and other sources) and have been opened up to increasing levels of competition with the view that this will compel them to operate at higher levels of efficiency. As well, it is thought competition will make the polytechnics more responsive to the demands of students and industry.[2] At the same time the polytechnics have been given more autonomy such that they have been able to move into the delivery of programs formerly denied to them.

The purpose of this paper is to look at some aspects of the cost efficiency of the operation of polytechnics in New Zealand between the years 1995 and 2002. The efficient operation of the polytechnics in New Zealand is important because they need to operate at high levels of cost efficiency if they are to provide the greatest possible contribution to the development of New Zealand's skill and knowledge base. In particular one issue to consider was whether the creation of larger polytechnic institutions could achieve lower unit costs and

therefore educate a greater number of students without significantly increasing costs. In order to achieve these larger institutions, the various polytechnics have attempted to 1) expand enrolments by diversifying into the delivery of degree programs, 2) attract additional students from overseas and 3) arrange (or been forced by circumstances into) mergers in order to create larger scale institutions. In the next section, a background account of the nature of the vocational education sector and the role of the New Zealand polytechnic is given. Following this, a section containing an analysis of the cost efficiency of New Zealand's polytechnics is provided, and in the final section some conclusions are given.

Background

Prior to 1989 the government owned and operated polytechnics in New Zealand did not compete directly with each other for students, nor was there substantial competition to them from the other tertiary education institutions such as the colleges of education, universities or private training providers. At this time the polytechnics concentrated on the delivery of vocational education and training programs at the certificate and diploma level, whilst universities concentrated on the delivery of degree and post-graduate degree programs, the colleges of education on teaching training, and the private institutions filled in the gaps. The polytechnics also tended to be located in separate towns or cities - Auckland and Wellington being unique in that they were the only centres in New Zealand that had more than one polytechnic. Polytechnics therefore tended to operate in quite separate locations and provided different qualifications from other tertiary institutions. Finally, the polytechnics enrolled almost entirely New Zealand residents, with students from overseas being a rarity. They were, therefore, largely immune from the competitive pressures of the global education market.

The passing of the Education Act 1990 saw the rigid distinctions between the three types of government institutions abolished and delivery of diploma and degree programs was allowed by all government providers as well as private providers. The changes in 1990 also gave polytechnics greater autonomy, which meant that they were able to compete directly with universities in the delivering of degree programs. As well they were allowed to establish campuses in centres outside their 'home' locality in direct competition with other polytechnics, and in many cases they began to attract overseas students. As part of the process of creating more autonomy for the polytechnics, the Education Act provided for an annual allocation of funds to each institution which then paid its own staff, owned its own buildings and, within the limit of its Charter and the funds available, planned its own destiny. It was hoped that by making them autonomous institutions and funding them according to the students they attracted, the polytechnics would become more market orientated and more

responsive to the needs of students and industry. Finally, the changes meant that there was much greater scope for private providers to compete with the polytechnics for students interested in upgrading their vocational skills.

The passing of the Industry Training Act 1992 saw funds being made available to industry to provide training programs.[3] At the same time, a National Qualifications Framework was established with formal levels created for the delivery of institutional qualifications as well as for those that were developed by a central government agency. This agency, known as the New Zealand Qualifications Authority, was not only responsible for the development of courses that could be delivered by the government and private providers but also for the accreditation and moderation of courses delivered by the various government and private bodies. Added together, the changes in the early 1990s meant that the New Zealand polytechnics became much more the subject of market competition than they were previously.

Table 1 provides some general data about the nature of the New Zealand polytechnic sector during the 1990s and the tertiary education sector more generally.

A number of factors can be discerned from these figures. First of all, although the polytechnics increased their enrolments throughout the 1990s (from 72,911 in 1991 to 95,782 in 2002) their share of the total tertiary education sector's formal enrolments declined. This was due not just to the conversion of the sector's largest institution – the Auckland Institute of Technology – to university status in 1999 but also to the rise in importance of the private training providers.[4]) However the conversion of the Auckland polytechnic did not prevent the average size of the polytechnics increasing substantially over the period (from 2,804 in 1991 to 4,789 in 2002) The second factor was the rise in the importance of degree programs in the polytechnics. At the beginning of the decade there were no degree enrolments in the polytechnics, but by 2002 the proportion of degree enrolments in them had risen to approximately 20 per cent. Another striking feature was the rise in the number of overseas students enrolled in New Zealand polytechnics whereas they were less than one per cent at the beginning of the 1990s. Finally, there was a fall in the average real level of government funding per equivalent full-time student at the polytechnics and a rise in the importance of private sources of income.

Taken together, this has meant that the polytechnics now compete more directly with the universities to attract degree students than they did in 1991; they compete with institutions internationally for students; they compete with private training providers; and they need to be more conscious of meeting the demands of students in order to ensure sufficient fee income. In these circumstances, one would expect that the pressure to operate at higher levels of cost efficiency would have intensified during the 1990s. One basic strategy to achieve this was to create larger institutions such that lower unit costs could be achieved through the creation of economies of size - which occur when the unit cost of providing a constant standard of education for a given

Table 1: New Zealand polytechnic data, 1991 – 2002.

	1991	1994	1997	2000	2001	2002
Student numbers						
Polytechnics	72,911	86,128	94,201	87,436	87,855	95,782
Colleges of Education	8,073	12,474	12,453	12,045	10,894	10,788
Universities	94,166	103,087	106,486	122,727	125,547	132,396
Wangana	0	279	1,088	2,972	11,281	2,755
PTEs	0	0	28,598	39,173	47,231	53,385
Total	175,150	201,968	242,826	264,353	282,808	319,886
Polytechnics share of enrolments (percent)	42	43	39	33	31	30
Number of polytechnics	26	25	25	23	22	20
Average size of polytechnics	2,804	3,445	3,768	3,802	3,993	4,789
Overseas students (Polytechnics)	na	880	1660	2416	4337	6899
Degree students (polytechnics)	0	6,120	17,875	17,337	18,151	18,716
Government grants/domestic EFTS (polytechnics) ($1995)	$8,044	6,794	5,619	5,276	5,572	5,821

educational profile falls as student enrolments rise. The most basic way in which this was pursued was for the polytechnics to diversify into the delivery of degree programs and also to try to attract overseas students. The alternative was to take part in mergers of institutions, but although this avenue has been pursued in a number of notable cases, New Zealand tertiary institutions have pursued mergers in a more tentative fashion than their counterparts in Australia or the United Kingdom (the TAFE Institutes in the former, and Further Education Colleges in the latter).[5] To some degree there is logic in this hesitancy given that New Zealand urban centres are on the whole far smaller than those in Australia and the United Kingdom and therefore the number of potential mergers that could achieve economies far more limited. In the New Zealand case, therefore, the tendency has been to merge very small, unsustainable polytechnics into larger ones on an individual basis rather than to press for widespread amalgamations as a part of government policy.

In attempting to pursue either of the main growth strategies - incremental growth or growth through mergers - the first step should be to determine the degree to which economies of size exist. Given the pressures of increased competition and reduced real government funding per equivalent full-time student, determining the strategy that achieves greatest cost efficiencies would seem to be a high priority for New Zealand's polytechnics.

Cost efficiency

Using data for the period between 1995 and 2002 taken from the Annual Reports of the New Zealand polytechnics, it is possible to show the association between average operating costs and the number of equivalent full-time enrolments of students. This association can be seen in Table 2.[6]

Table 2:   Economies of size of the New Zealand polytechnics, 1995 to 2002

EFTS	Average Cost (000)	Frequency
0 < 1000	11.31	28
1000 < 2000	11.62	58
2000 < 3000	9.87	39
3000 < 4000	8.34	18
4000 < 5000	10.36	13
5000 < 6000	11.23	15
6000 plus	9.61	7

Source: Annual reports of the New Zealand polytechnics. The data in this table does include the statistics for the Auckland Institute of Technology after its conversion to university status in 1999. It does not include data for the Open polytechnic

Average costs were calculated by dividing total operating costs by the number of equivalent full-time students. Various intervals are presented in Column 1 of Table 2, the average costs are presented in Column 2, and the number of institutions falling within each interval is listed in Column 3. It is clear from Table 2 that average costs were relatively high for those institutions that had less than 2,000 equivalent full-time students. That is, there are economies of size associated with increasing the number of full-time equivalent students. The median number of equivalent full-time students over the 1995 to 2002 period was 2,040, while the mean was 2,500. On the basis of Table 2, an increase in the number of students from the lowest category (less than 1,000) to say 3,500 would lead to a reduction in average cost of $2,970 dollars. That is, increasing enrolments by 2,500 would lower average annual operating costs by $2,970 per student.

The association between average operating cost and the number of students can be seen also in Table 3.

Table 3: Regression Analysis of Economies of Size in the New Zealand Polytechnics, 1995 to 2002

Variable	Y = AC Coefficient (t-statistic)	Y = AC Coefficient (t-statistic)	Y = AC Coefficient (t-statistic)	Y = OC Coefficient (t-statistic)	Y = OC Coefficient (t-statistic)
Constant	9019.95 (56.21)***	9317.81 (40.89)***	9876.57 (23.38)***	620.77 (0.88)	-3854.93 (-0.84)
EFTS	-0.08 (-2.18)**	-0.28 (-2.83)***	-0.42 (-2.98)**	8.38 (26.60)***	8.20 (17.51)***
EFTS squared	-	0.00002 (2.24)**	1.83E-05 (2.30)**	-	-
Fixed assets	-	-	0.01 (1.51)	-	755.47 (1.35)
Part-time ratio	-	-	23.14 (0.85)	-	107.13 (2.06)**
Academic ratio	-	-	-365.07 – (-1.66)	-	-831.17 (-1.81)*
Diversity	-	-	-	-	-1944.62 (-1.00)
Wald test	-	7.06**	-	-	-
N	178	178	178	178	178

Y = dependent variable, OC = operating cost, AC = average operating cost. *, **, *** statistically significant at the ten percent, five per cent and one percent levels, respectively.

Table 3 reports the results of ordinary least squares regressions of average costs and enrolment size. Column 2 presents the results with just the number of students variable. Average cost falls by 0.08 for each additional student, or by $80 for each thousand extra students. Column 3 introduces non-linearities by including enrolments squared. Both variables are statistically significant at the 10 per cent level, and the Wald test indicates that the equivalent full-time student terms are jointly statistically significant. Increasing the number of students decreases average costs, but does so at a decreasing rate. Several control variables were included in order to control for the impact of other factors on average costs. These included Fixed Assets, which is the real value of fixed assets; the part-time ratio, which is the ratio of the number of part-time students to full-time students; and the Academic Ratio, which is the ratio of teaching staff to general staff and administrative staff.[7] These variables were included to capture any differences in operating costs arising from different levels of fixed assets, greater concentration on degree level studies, and whether the mix of teaching to general and administration staff had an impact on cost. These results are presented in Column 4. The only control variable that comes close to significance is the Academic Ratio – increasing the number of teaching staff relative to general and administrative staff lowered the average operating cost. In other words, lowering the number of general and administrative staff for a given level of students lowers costs.

The dependent variable in columns 5 and 6 was operating cost (not average cost). The most important explanatory variable was, again, the number of students. In column 6, other explanatory variables were added. The Academic Ratio was again statistically significant and had a negative coefficient. The part-time ratio was also statistically significant, indicating that higher ratios of part-time students increased operating costs. In column 6 a diversity index was introduced which was constructed by comparing the number of disciplines offered by each polytechnic to the number of disciplines offered throughout the polytechnic sector. Higher numbers of this index indicate a greater degree of course diversity. In 2002, this index ranged from 0.67 to 1,[8] but it was never statistically significant, regardless of the model estimated. (The full set of results is available from the authors).

The analysis presented here explores total operating costs for the polytechnics as a whole. One direction for future research is to explore average and total operating costs at the cost centre level, incorporating differences in the mix of courses and business strategy. This would provide information on cost efficiency at the cost centre level.

The regression coefficients from Column 3 imply that up to a level of 7,778 enrolments, average costs are falling, and beyond that point, average costs are rising so there is no cost advantage to expand size beyond this point. This is higher than what is suggested by Table 2. It should be noted that there are only two instances over the 1995 to 2002 period of New Zealand polytechnics in this sample exceeding this level of enrolments. The coefficients from Column 3 imply that in 2002 an expansion in enrolments to 3,500 for each of the smaller polytechnics would result in a total cost saving of $4.3 million. This represents an average cost reduction of around 5 per cent.

Summary and conclusions

A number of conclusions from this study can be made. First of all, most of New Zealand's polytechnics are too small to achieve much in the way of economics of size. Further growth therefore will enable them to lower average unit costs. Some mergers of the smaller polytechnics might be expected to create the potential to create economies except that the smaller polytechnics tend to be in regional centres which means that mergers would create multi-campus institutions involving problems that would need to be overcome before the economies could be achieved. Further growth through the delivery of additional programs, including degree programs, would seem to promise some possibilities. Where the smaller polytechnics have become engaged in the delivery of degree programs, they have done so in conjunction with larger polytechnics or universities - a fairly rational means by which they can increase their enrolments, thereby lowering average unit costs while at the same time avoiding the costs of too broad a diversification. A high enrolment level of degree students seems to be no impediment to lowering average unit costs.

The second major conclusion that can be made is that the largest polytechnics must be at a size that brings them close to achieving most of the possible economies of size. Polytechnics such as the UNITEC Institute of Technology (9,565 equivalent full-time students in 2002), Manakau Institute of Technology (8,406 equivalent full-time students in 2002), and Christchurch Polytechnic Institute of Technology (6,225 equivalent full-time students in 2002) would appear to be approaching - or have reached - the point where the majority of economies of size have been realised. Although there might be economies possible from these institutions taking over smaller polytechnics, there would appear to be little reason in terms of economies for subsuming these institutions into substantially larger institutions.

Finally, the mergers of polytechnics that have occurred in New Zealand so far would appear to lie within the range of the achievement of possible economies of scale. The merger of Wellington Polytechnic with Massey University, Hutt Valley Polytechnic with the Central Institute of Technology, and the take over of Wanganui and Wairarapa polytechnics by UCOL all saw relatively small polytechnics disappear and larger institutions take their place. The close proximity of these polytechnics to each other would probably have meant that the difficulties involved in operating multi-campus institution would have been avoided and some economies of size achieved

It seems inevitable that in New Zealand the polytechnics will pursue growth either through the delivery of degree programs or through the merger of institutions. There is potential in either strategy for the achievement of further economies which could potentially lower average unit costs, but in each case these strategies should be pursued with some caution. In some cases a number of the polytechnics probably could achieve most of the economies of size simply through growth in numbers in existing courses, with possibly a few additions and a relatively small number of

overseas students. In these circumstances these polytechnics could quite easily avoid taking drastic measures such as involving themselves in complicated mergers which may not achieve what they promise.

Malcolm Abbott is Dean of the School of International Studies at AIS St Helens, in Auckland New Zealand.

Hristos Doucouliagos is Professor of Economics at Deakin University, Australia.

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Endnotes

[1] Although there is no universally accepted definition of what constitutes vocational education and training its basic characteristic is that it uses a practical and task orientated approach. Vocational education and training can also be viewed as instruction that is directly related to the employment activities of the trainees. This contrasts with general education, which is discipline-orientated and takes students to progressively more advanced levels of appreciation and understanding in science and the humanities. Of course the New Zealand polytechnics do provide general education but their courses are predominately vocational in nature.

[2] For a history of the polytechnics both their origins and the changes that have occurred to them during the 1990s see Abbott 2000.

[3] As many as 106,997 trainees participated in 2002 in the Industry Training Strategy under the Industry Training Act. As part of this program $38.2 million was invested by industry along with $90.6 million by government. (Tertiary Education Commission 2003).

[4] As well the Wellington Polytechnic achieved university status however this was through the merger of it with Massey University. The conversion of the Auckland Institute of Technology and take over of the Wellington Polytechnic saw a substantial number of polytechnic students transferred into the university sector.

[5]   For an evaluation of mergers in the United Kingdom see LSE/Centre for Education and Industry (2003). For the Australian case see Abbott and Doucouliagos (1999).

[6]   The data in table 2 dos not include that for the Open Polytechnic. Data from this institution was not available for every year and it is quite different in its course delivery mode than the other institutions. For these reason it was not included. As well, data for the Auckland Institute of Technology were included for the years 2000, 2001 and 2002 when this polytechnic had become a university (the Auckland University of Technology).

[7]   A variable for higher education enrollments was also introduced but was not statistically significant.

[8]   Discipline offerings in 2002 broadly fall into the following categories: natural and physical sciences, IT, engineering, architecture and building, health, education, business, society and culture, creative arts, food and hospitality and a mixed field category.