Just because New Zealand's post-secondary education and training sector is dominated by government owned institutions does not mean that they are not subjected to market pressures. The history of New Zealand's post-secondary educational institutions seems to indicate that the pressures of demand brought by students and industry have very heavily influenced their development. In the following section the role-played by market forces in influencing the historical development of New Zealand's vocational education and training sector is examined as well as the role that this sector has played over the longer term in developing New Zealand's human capital

The Origins of Technical Education in New Zealand[1]

Concern was first expressed about the insufficient skill level of the New Zealand workforce in the late nineteenth century. Before the turn of the century technical education was provided by a few secondary schools, which provided some semi-vocational subjects, and continuation classes conducted in a sporadic fashion in the school of mines in the South Island and the mechanics institutes. The lack of formal provision of technical education in New Zealand in the late nineteenth century mainly stemmed from the fact that there was no great concentration of manufacturing industry in New Zealand and consequently no great demand for technical skills. Across the Tasman in Australia the development of a large scale mining industry led to the establishment of a number of Schools of Mines and Industry which laid the basis for the development of technical education in that country. The lack of either a large scale manufacturing sector or sustainable mining sector meant that technical education tended to be neglected in New Zealand.

Formal provision of technical education was also made less necessary by the fact that the colony could draw on the skills of the many immigrants that entered the country from the United Kingdom. Employers were little interested in promoting the instruction of their workers and either under valued formal training or preferred to free ride on the training effort of others by recruiting workers who were already trained. This was a view that was not just confined to New Zealand. English industrial managers tended to believe that education and training was not under resourced (Evans and Wiseman, 1984). Private and local community attempts were unable to establish vocational education and training in New Zealand on a permanent basis and it was not until the Government decided to intervene at the turn of the century that vocational education and training was established on a firm footing (Nicol, 1940).

In Great Britain at this time there was some concern about the under development of technical education. In 1882-84 the Royal Commission on Technical Instruction (Samuelson Reports, 1882-84) attributed part of the reason for Britain's decline in international competitiveness to a neglect of technical education. In 1889 the Government passed the *Technical Instruction Act*, which empowered local authorities to raise a penny rate for the aid of technical education and in the following year central government funds were made available. The main difference between the British and New Zealand Government intervention was that the British scheme still left the chief initiative for the conduct of technical education with local authorities rather than with the central government, as was the case in New Zealand. Nevertheless both approaches conceded the necessity for government intervention of some kind.

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[1] Much of the material in this section is reproduced from Abbott (2000).

The first intervention by the New Zealand Government came in January 1885 when the Premier and Minister for Education, Robert Stout, tried to encourage the secondary schools to provide technical classes. In a circular letter dated 19 January 1885 the Secretary for Education, at Stout's direction, urged the Board of Governors of Education in the various districts of New Zealand to consider: 'the great importance of including in the program of the secondary schools as much instruction as possible in subjects that have a direct bearing upon the technical arts of modern life' (Nicol, 1940, p. 22). Stout also urged the university colleges to provide technical instruction classes. There was virtually no response and so Stout pursued the alternative strategy of granting the Wellington Board of Education a site for the building of a school of design. The Board hired a drawing master and the Wellington School of Design was opened in 1886. Further technically orientated evening schools were founded in subsequent years (Dunedin Technical School 1889, Auckland Technical School 1895, and Wanganui Technical School 1892). In the years that followed the New Zealand Government became increasingly involved in the provision of technical education. After two government-sponsored investigations the government passed the *Manual and Technical Instruction Acts* in 1900 and 1902.[2] These Acts gave local authorities the power to spend money on technical education and make land grants. Government grants were also authorised to pay for the cost of buildings, equipment and materials and allowed for the first technical school inspectors to be appointed. The intention of the Education Department was not to establish separate technical schools but to encourage the teaching of technical subjects in the existing district secondary schools. The secondary schools again failed to respond and as a consequence existing evening schools set up day classes and new technical schools were established. The Wellington School became the Wellington Technical School in 1901 and the Christchurch Technical College was established in 1907. In 1913 the Auckland Technical School was redesignated the Seddon Memorial Technical College. Prior to the First World War technical colleges and schools were opened in other major New Zealand centres and enrolments expanded (see Table 3).

In the first half of the twentieth century young New Zealanders acquired skills mainly through apprenticeships and on the job training (as in Great Britain and Australia) coupled with part-time tuition at a local technical school or college. The New Zealand Government assisted the provision of technical education and training by providing financial assistance to technical schools and colleges operated directly by the Department of Education. This intervention took place in response to the disinclination on the part of New Zealand's employers and existing secondary schools to conduct technical education programmes. The inability of trainees to finance their own training (especially the apprentices) and the inability of firms to capture the full benefits of training because of the possible 'poaching' of trained personnel probably explains the failure of the market to provide an adequate level of technical education. Employers tended not to be interested in promoting the instruction of their workers and day release facilities to attend the technical schools and colleges were almost non-existent. Trainees tended to take the initiative themselves in trying to achieve qualifications, which meant that they had to mainly attend evening classes. Given the small numbers involved in post-school education and training, and the disinclination on the part of employers to release apprentices for day classes, it appeared to the Government that the easiest way to provide evening classes in technical training was to attach them to the technical day schools.

Despite these difficulties post-school technical education did expand during the 1920s and 1930s. By 1930 there were just over 10,000 people enrolled in technical classes in New Zealand (*New Zealand year book*). This was approximately 0.7 per cent of the New Zealand population at that

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[2] A.D. Riley, the first principle of the Wellington school, carried out these two investigations in 1888 and 1898.

time (1,506,800 in 1930).[3] Even at that time technical education was more important that university level education in that the numbers undertaking post-school technical education were over twice the numbers enrolled at the colleges of the University of New Zealand and the two agricultural colleges combined (*New Zealand Year book*).

Despite the importance of this government intervention in establishing the technical schools it was the demands of industry and their students that had the greatest influence on their basic character. In this period the demands of New Zealand industry for technical training were not great due to the absence of a substantial industrial sector. The technical schools and colleges therefore concentrated more on their secondary school classes for adolescents rather than post-school programmes. The technical schools offered a variety of evening programmes, mainly of a vocational nature, which were attended both by adults and adolescents, many of whom were apprentices studying to gain trade qualifications. Amongst the technical trade classes engineering and the building trades were prominent. In 1928 the Education Department instituted technological examinations for a range of trades such as plumbing, carpentry, joinery, building construction, painting and decorating, motor mechanics, and mechanical engineering. At this time many trainees preferred to sit the examinations of the London City and Guilds Institute, which gave them qualifications that were more universally recognised. The bulk of students, however, were engaged in elementary and advanced commercial subjects. In 1938, for instance, there were 4,359 trainees enrolled in commercial subjects compared to 4,100 in engineering and building trades (Nicol, 1940, p. 207). These students studied subjects such as bookkeeping, advertising, secretarial work, accounting, banking and insurance in preparation for sitting either the Government examinations or those of voluntary associations such as the Chambers of Commerce. The prominence of commercial and building classes was simply a reflection of the basic nature of the New Zealand economy of the time. The New Zealand economy was heavily dependent upon agriculture, but also possessed a substantial service sector comprising a large number of public servants, commercial employees and building tradesmen who wished to upgrade their skills and qualifications.

Because of the small numbers involved in the formal training of apprentices and the lack of demand for non-university educated technicians, the establishment of separate tertiary level technical colleges in New Zealand prior to the Second World War was unthinkable. Tertiary level technical colleges require specialised staff, buildings and equipment needed for apprentice and technician training which in the pre-war climate would simply not have been fully utilised had they been provided. Instead, the specialist teachers in the technical colleges who did not have enough tertiary level classes to occupy all their time carried out teaching in adult evening classes and at the secondary level. After the war as tertiary education numbers grew it became possible to envisage that the secondary school functions of the technical colleges could be hived off, leaving the senior technical sections to stand alone as tertiary technical institutes.

Although in the pre-second world war government technical school and colleges mainly provided period technical education the nature of these institutions was very heavily influenced by the demands put on them by trainees and industry. The courses provided tended to be in commercial and building subjects a product of the nature of the New Zealand economy at the time. The emphasis on night classes as opposed to day classes and part-time as opposed to full-time student

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[3] In comparison around seven per cent of New Zealand' 3,975,900 population in 2002 was enrolled in courses at a tertiary institution of one form or another.

was also a reflection of the demands put on the technical schools/colleges by trainees. To a large degree the government simply responded to public and private demands to provide training courses of the type that was at the time envisaged as necessary by industry.

The Technical Institutes

After the Second World War the technical schools and colleges began to transform themselves in response to changing economic circumstances and demands put on them. Before the war trade training classes were generally held in the evenings and it was not until the passing of the *Apprentices Act* 1948 that apprentices were compelled to attend trade classes. The New Zealand apprenticeship schemes, therefore, become based upon the principle that the theoretical aspects of training should be taught away from the work place and that apprentices should be able to attend classes during work-time. In 1949 the New Zealand Trades Certification Board was also established to oversee the development of trade training in New Zealand, prescribe courses, set standards and conduct exams. This was an important step and placed New Zealand ahead of the United Kingdom in the development of the educational component of trade training. Up until the 1960s there was no obligation placed on British employers to provide formal training or release facilities for the purposes of external instruction. Nor was there any recognised outside authority that supervised apprenticeship training. Unlike in New Zealand during the 1950s only a minority of British apprentices sat examinations for formal qualifications, instead receiving their status as tradesmen on completion of their apprenticeship period. Another important post-war development was the establishment of the Technical Correspondence School (which later became the Open Polytechnic) in July 1946. This institution grew out of the wartime Army Educational and Welfare Services study courses and provided correspondence instruction in vocational and technical courses for apprentices and advanced students unable to attend technical schools. The establishment of the Correspondence School meant that it was possible to compel all apprentices, regardless of their location, to complete technical courses and sit examinations.

Until the 1950s the technical colleges were predominantly secondary schools but the entry of day release apprentices into the technical colleges began the process of creating tertiary technical institutions in New Zealand. After the Second World War there was a gradual rise in interest in technical education as New Zealand's industrial base expanded. The growth and diversification of the economy into technically more demanding fields and the expansion of professional and clerical employment helped to lead to an increase in demand for formal education and training.

As early as the 1930s there were calls from the Technical Education Association for the establishment in the main centres of 'technological institutes', separated from the secondary schools (Hockley 1990). In 1952 at the annual conference of the Technical Education Association in Dunedin, the Chief Inspector of Technical Education, G.V. Wilde, advocated that technical education should divest itself of its secondary school responsibilities and concentrate more fully on technical and trade training (Hockley, 1990). In the 1950s, with the expansion of New Zealand's industrial sector, industry demands that technical schools turn out technicians trained at a level between that of tradesmen and university educated technologists began to arise. The most strenuous efforts were made by the engineering profession which wanted to have specified a role for a highly trained person whose qualifications were derived, not from study in a university school of engineering, but from theoretical studies taken in conjunction with industrial experience. In 1954 the Department of Education sponsored a committee to consider the training of all senior workers in engineering. Amongst its recommendations was that the technical colleges should establish middle level engineering courses. These efforts led to the establishment of the New Zealand Certificate in Engineering in 1955, which proved to be the pivotal factor that led to the creation of tertiary level vocational education and training institutions in New Zealand. Although initially there were only small numbers of full-time students taking the Certificate courses, growth in numbers was steady (from 40 in 1955 to 1,120 in 1958). Further Certificate courses were soon established in building, draughting (architectural), science, land surveying, quantity surveying, laboratory technicians and later commerce The Technicians Certification Authority of New Zealand was established in 1958 to prescribe courses and syllabuses and conduct national examinations.

The introduction of the technician certificates filled a conspicuous gap in New Zealand's technical educational sector. During the 1950s both Australia (with a substantial diploma course section attached to technical colleges) and Great Britain turned out thousands of certificate and diploma graduates every year. The establishment of the certificate courses, and their expansion, also stretched the spread of responsibilities of the technical colleges to include at one extreme the education of 12 year olds, and at the other end the education of professional engineers. At this point it seemed logical to divide the colleges into secondary and tertiary level institutions.

The move to shift technical education into tertiary level institutions received a boost in 1956. Dr C. Beeby, the Director-General of Education, in a speech to the Senate of the University of New Zealand, noted the world wide trend toward moving technical education into tertiary level institutions and advocated that this should also occur in New Zealand. Beeby's vision of the type of tertiary technical institution was largely adhered to over the following thirty years. In particular he envisaged that the type of institute established would be a vocationally orientated teaching institution rather than one based on any substantial research role. He stated that:

> It would be difficult to make a case for the establishment of a technological institute in New Zealand, if by that term is understood a college like the Imperial College of Science or Massachusetts Institute of Technology. There is, however, a case for the setting up of a less ambitious type of national college from which a technological institute might arise if the need for it ever became apparent (quoted in Offenberger, 1979, p. 17).

At the same time that the demands for greater numbers of skilled technicians were having their influence on the technical schools the size and nature of secondary education was also changing. Gradually the view emerged that secondary education should not concern itself with vocational training, but should provide a more broad approach as a basis for later specialisation in academic or technical courses. Increases in the numbers of students going onto secondary education also meant that the technical schools in major centres became substantial institutions in their own right. Beeby in 1956 envisaged that:

> At least three of these (metropolitan technical schools) may be expected to split into two separate institutions, a technical high school and a technical college responsible for all part-time courses and all senior technical work. Each institution will have its own independent principal...The technical college will increase its daylight training at all levels, and will concentrate particularly on courses for technicians (Beeby 1956, pp. 17-18).

The Currie Commission, which investigated the state of New Zealand education in the years 1960-62, supported the move to establish separate tertiary level technical institutes in the major centres. Although the Currie Commission looked at the nature of the link between economic growth and investment in vocational education and training its concerns were of a different nature to those expressed by government reports on education during the 1980s and 1990s. In particular the Currie

Commission was concerned about the need to train: 'specialised craftsmen, technicians, scientists, and technologists to meet the demands of a diversified and expanding industrial economy'. The Commission assumed that economic growth could be taken for granted and that the basic problem was one of alleviating a skill shortage (Currie Report 1962, pp. 386-7). In recent years government reports have emphasised that investment in vocational education and training is a basic prerequisite of economic growth and that further and more efficient investment in this field will help to raise growth levels and living standards.

The first technical institutes that were established were the Central Institute of Technology at Petone in 1960 and the Auckland Technical Institute (which later became the Auckland Institute of Technology and later Auckland University of Technology) in 1964. The Central Institute of Technology was established to provide courses in areas, such as pharmacy, chiropody and occupational therapy, that there was not enough national demand for to be offered in technical colleges around the country. The Auckland Technical Institute on the other hand was formed from the Seddon Memorial Technical College, which at the time was New Zealand's largest technical school. The Wellington Polytechnic was established in 1962, followed by the Christchurch Technical Institute in 1965, Otago Polytechnic in 1966 and Hamilton Technical Institute in 1968. These institutes were formally recognised by the government in the *Education Act* of 1964 (see Table 4).

Until 1968 technical institutes were only established in the major centres where there was enough demand for vocational courses to justify the establishment of separate institutions. Until this date the technical schools in smaller centres continued to meet the needs of post-secondary trade training. In 1969 the Government gave approval for the establishment of technical institutions in centres where there was sufficient technical work to occupy 10 tutors full-time, which helped to lead to the establishment of technical institutes in provincial centres. In 1972 the government decided to allow for the establishment of so-called "community colleges", which would provide traditional technical education in conjunction with other broader educational services. The first community college was opened at Hawkes Bay in 1975 and others were to follow in other parts of the country. During the 1980s the technical institutes and community colleges were reclassified as polytechnics to better reflect the wide range of courses that they were providing. The technical institutes began to provide more non-vocational courses, while the community colleges provided vocational education as well as non-vocational courses. The difference between the two types of institutions, therefore, was not as great as their separate titles would have implied.

The technical institutes were designed to provide trade training courses, certificate and later diploma courses and a wide range of short courses. They were encouraged to respond to demand, as courses were run and attracted resources as long as they could show that there was demand from students for the courses or from local industry and commerce. They were, however, expressly forbidden to grant degrees and so therefore were prevented from developing themselves along the lines of the polytechnics in England or the colleges of advanced education in Australia. Australia developed its 'binary' system of higher (degree level) education after the release of the Martin Report in 1964-65 and England followed suit after the release of a White Paper in 1966 (Pratt 1997). In New Zealand the arguments for creating a binary system of higher education during the 1960s were considered but rejected on the grounds that there was a greater need to develop the trade and technician training sector of tertiary education. Another event in New Zealand that discouraged the move to a binary system of higher education in New Zealand was the break up of the University of New Zealand in 1961. This split of the University into four separate universities and two agricultural colleges meant that New Zealand in the 1960 already possessed a sufficient number of higher education institutions to accommodate a growth in the number of students demanding degree courses.[1]

One of the basic characteristics experienced by the binary systems, as they existed in England and Australia was that of 'academic drift' (Pratt, 1997). Broadly speaking this was the tendency for tertiary institutions to aspire to university status and for the institutions to take on some of the characteristics of universities. In this process institutions seek greater freedom from government control and external validation. One indicator of academic drift has been the proportion of students studying part-time and a rise in the number of full-time, pre-employment students (Pratt, 1997). Academic drift of the sort experienced in England and Australia can provide particular problems in the provision of the vocational education and training. In the Australia the establishment of colleges of advanced education in the 1960s meant that the technical colleges involved in the conversion quickly vacated responsibility for providing trade certificate and diploma courses, leaving the Australian and State Governments with the need to develop a new sector of the education system which became the so-called TAFE sector (Technical and Further Education). A similar experience took place in England where the polytechnics in the 1970s expanded their degree offerings at the expense of certificate and diploma courses necessitating the development of Further Education colleges in that country in the 1970s and 1980s.

In the late 1960s there is some indication that some members of the government were willing to allow the technical institutes to provide degree courses and in effect create a binary system of higher education. In 1968 the Minister of Education spoke of the likelihood that the Central Institute of Technology would become 'virtually a technical university' (*New Zealand Parliamentary Debates*, 1968, vol. 256, 996). Later departmental statements implied that teaching to degree level in the technical institutes was not favoured. The Working Party on Technical and Industrial Academic Awards set up by the Advisory Committee on Educational Planning which reported in 1971, opposed the establishment of a binary system:

> The quite dramatic decisions in Australia and in the United Kingdom, which led to the establishment of substantial numbers of institutions of higher education more or less competitive with universities, were directly influenced by the conditions in those countries, which do not exist in New Zealand. It is not the Working Party's opinion that New Zealand should or could realistically embark on a similar program of rapid dual development (quoted in Offenberger 1979, p. 21).

At the end of November 1974 the report, Directions for Educational Development, was presented to the Minister for Education. Amongst its recommendations it advocated that New Zealand should avoid: 'a policy which divides technical institutes into trade schools and schools of higher education, with the latter aspiring to become alternative universities'. The occurrence of academic drift therefore did not occur in New Zealand before 1990, the polytechnics concentrating on trade training and sub-degree level courses mainly to part-time students who were already in employment.

After the establishment of the technical institutes in the early 1960s these institutions grew at a rapid rate, in response to a growing demand for trade, certificate and diploma courses. The institutes diversified their activities and additional courses were established in response to an increasing demand for training. Student numbers enrolled at the technical institutes (polytechnics) grew steadily during the 1960s and 1970s and by 1981 they constituted over one half of students enrolled at the tertiary level (Table 2). In 1964 when they were recognised they formally enrolled 12,915 part-time and 872 full-time students (as well the Technical Correspondence Institute had

9,066 students). By 1976 these figures had risen to 4,260 full-time students and 21,712 part-time and extra-mural students. As well they enrolled large numbers of student in short courses.

The vast majority of these students were enrolled in part-time trade certificate and diploma courses. In 1981 New Zealand possessed five universities whose expansion in the preceding twenty years had been adequate to meet the demands of New Zealanders for degree courses. There was at this time little pressure for the polytechnics to deliver degrees programmes and most had their work cut out for them keeping up with the expanding demand of New Zealanders for trade, certificate and diploma courses. This meant that up until 1981 they were able to avoid the problems of academic drift, which were experienced in the United Kingdom and Australia. The system as it evolved was government dominated on the supply side in the sense that separate technical institutes were established in each centre and therefore they did not directly compete with each other for students. Funds were allocated from the budget of the Department of Education so the system could be envisaged as being one of central control and structure. The institutions themselves did however have to respond to the demands of the public in order to enrol student and therefore attract funds from the Government. The institutes and community colleges varied considerably in size depending on their location and the range of courses they offered. In terms of the programmes offered industrial trades and commerce courses predominated in most of these institutions a product of the nature of the New Zealand economy at that time (see Table 4).

Table 4: Enrolments in Polytechnics by ISCED Level

	3 Trade certificate	4 In service refresher	5 Technicians certificate/diplomas	6 Degree or equivalent	7 Post graduate	8 Foundation	Total*
1975	25,939	-	20,132	-	-	-	46,071
1980	35,064	-	28,278	-	-	-	63,342
1985	30,121	-	33,976	-	-	-	64,097
1990	24,874	17	25,931	1,937	-	5,689	54,448
1997	40,647	5,685	28,751	17,649	226	1,243	94,201
	Certificate		Diploma				
2002	55,924		21,142	17,919	797	-	95,782

Source*: Education Statistics of New Zealand*

* does not include students enrolled in community or hobby classes

Recent Times

The slow down of economic growth during the 1970s and 1980s led to a renewed interest on the part of New Zealand's policy makers in expanding participation in tertiary education. During the 1980s a wide range of government bodies undertook investigations of New Zealand's tertiary education system.[2] The Hawke Working Party report of the late 1980s attempted to draw all of the different strands of the various reports together. Amongst other things it advocated that polytechnics be made autonomous institutions, operating under their own governing councils and should be allowed to offer degrees if certain standards were met. Already there was evidence that the responsibilities of the polytechnic sector and that of the universities were overlapping but the Hawke Report also concluded that polytechnics were failing to attract sufficient numbers of students in the traditional trade certificate and technicians certificate courses. Certainly there does seem to be some evidence of a fall in enrolments in these courses during the late 1980s (numbers enrolled in trade certificates and diplomas slumped during the late 1980s; see Table 4). Instead the polytechnics were beginning to attract increasing numbers of school leavers into fulltime courses. During the 1980s full-time enrolments at the polytechnic rose from 6,915 in 1981 to 24,334 in 1991 (from 10.5 per cent of formal enrolments to 28.6 per cent; *Education Statistics*). Presumably many of these school leavers would have preferred to undertake fulltime study in Degree programmes at universities but could not be accommodated by them. Also by then the nature of university education had changed and moved in a more vocational direction. The OECD in 1991 recorded that the universities in member countries showed an: 'increased vocationalisation' and a tendency to assume a growing number of functions, which were originally perceived as being specific, sometimes exclusively non-university programmes. This led to a certain blurring of the boundaries between the two sectors and the possibility of the polytechnics developing degree programmes in vocationally orientated subjects.

The final outcome of the reports and investigations were the two Department of Education policy documents *Learning for Life* and *Learning for Life II*. According to *Learning for Life*: 'The main focus and predominant role of polytechnics will continue to be vocational education and training' (*Learning for Life*, pp. 18-19) but the polytechnics were given the power to broaden their range of activities. The general thrust was to release the polytechnics (and other educational institutions) from departmental control. The Department of Education was abolished and replaced by a Ministry whose job it was to be responsible only for overall policy. Until 1989 New Zealand's education system was largely under the administration of the Department of Education. There were a number of separate national statutory bodies such as the Trades Certification Board (for trade level qualifications) and the Authority for Advanced Vocational Awards (for technician level awards) that were important to the polytechnic sector. The Ministry of Education became responsible for providing education policy advice to the government and for overseeing the implementation of approved policies and for the distribution of funds to the various educational institutions. The *Education Amendment Act* provided for an annual allocation of funds to each institution, which was to be spent according to its own judgement. Each institution would pay its own staff, own its own buildings and within the limit of its Charter and the funds available, plan its own destiny. A pool of contestable funds was also established which the polytechnics or private providers could apply for. The purpose of the changes was that 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.

As part of the reform process a national qualifications authority (the New Zealand Qualifications Authority) was established. In the process the government funded bodies, which had previously been responsible for controlling standards, analysing training needs and conducting examinations like the Trades Certification Board, the Authority for Advanced Vocational Awards and Vocational Training Board were abolished. Under the old system the boards were comprised of representatives of professional and technical bodies together with educational professionals and they prescribed courses and set and marked examinations. The polytechnics conducted the teaching, and successful graduates from each course received New Zealand Certificates. From June 1990 each individual polytechnic was free to develop its own courses subject to accreditation and validation by the New

Zealand Qualifications Authority although the Authority also retained responsibility for prescribing some courses, which polytechnics could choose to deliver.

During the 1970s and 1980s the polytechnics maintained their concentration on pre-degree level certificates and diplomas, however there was a decline in the number of students undertaking trade courses (Table 4). Trade certificate enrolments maintained themselves at a high level during the 1990s but certificate and diploma course enrolments have slipped as degree courses have taken their place. Since the polytechnics were given the opportunity to grant degrees the process of academic drift in a few of the larger polytechnics has occurred at a rapid rate. In the Auckland based UNITEC Institute of Technology and Auckland Institute of Technology degree students quickly outnumbered sub-degree student numbers. Degree numbers as a proportion of the total number of formally enrolled students peaked in 1999 at 31 per cent. This figure fell when Auckland Institute of Technology gained university status but in 2002 24.3 per cent of polytechnic students were enrolled in Degree courses (Table 5). Across the system the proportion of students studying part-time also plummeted, as mentioned earlier an indicator regarded by some commentators as a sign that these institutions are moving away from sub-degree level vocational education and training. From around one third of students in the late 1980s fulltime students as a proportion of total students were just under one half of students by the early 2000s.

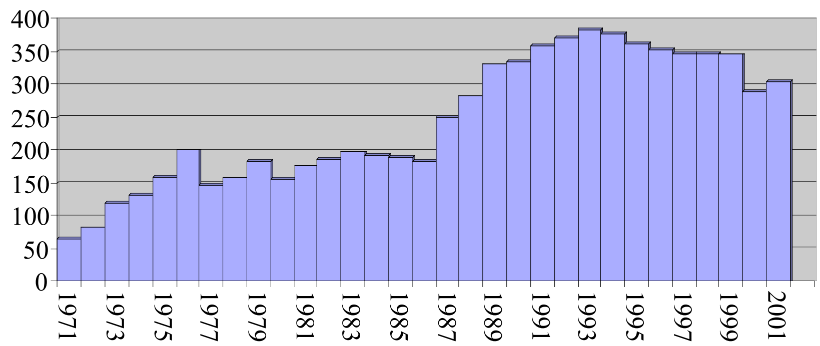
The move toward making tertiary institutions more responsive to changing demand continued in 1998 with the release of the White Paper of the Tertiary Education Review. The first Tertiary Review announcements made were the funding decisions included in the 1998 Budget. This removed the cap on student numbers so that all students, no matter where they studied in New Zealand, as long as they are studying for an approved qualification with a quality provider, would receive government funds towards the cost of their course. One characteristic of the New Zealand vocational education and training sector in the 1990s has been the growth of private training providers who have moved very substantially into the sub-degree sector of post-school education. This has created a degree of competition to the polytechnics that they did not experience prior to 1990. At the same time a number of polytechnics have attempted to expand their activities by opening campuses in centres in direct competition with other polytechnics. Overall this has meant that student now have a greater choice of institution to attend and has put more competitive pressure on the polytechnics.

Table 5: Student Numbers at New Zealand Polytechnics

	Student numbers	International students	EFTS/ Academic staff	Higher education
1986	79,007	na	12.8	0
1987	79,740	na	12.0	0
1988	76,539	na	10.9	0
1989	74,219	na	na	1,036
1990	85,239	na	na	1,937
1991	69,069	na	9.4	4,457
1992	98,646	na	13.5	2,748
1993	88,427	na	12.0	8,216
1994	86,128	880	na	na
1995	94,389	774	14.1	13,926
1996	95,346	983	14.8	14,586
1997	94,201	1660	14.5	16,976
1998	95,319	1440	15.1	na
1999	100,037	1824	15.0	23,558
2000	87,438	2416	15.6	17,337
2001	87,855	4337	16.0	18,151
2002	95,782	6,899	na	18,716

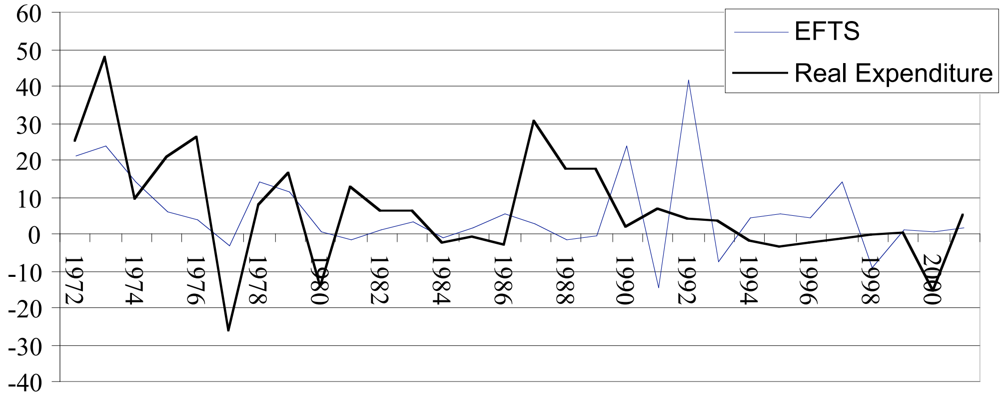
Source: *Education Statistics of New Zealand*

Figure 1: Government Expenditure on Polytechnics/Technic Institutes, $million 1990



Source: New Zealand, Department of Education, Ministry of Education

Figure 2: Growth of Government Real Current Expenditure Polytechnics and Equivalent Full-time Students



Source: New Zealand, Departmen of Education, Ministery of Education

Table 6: Polytechnics Enrolments – Discipline Areas

	1980	%	1990	%	2000	%
Education	19	0	212	0.4	3,700	4.2
Art/Music/Handicrafts	293	0.6	1,222	2.1	4,891	5.6
Humanities	0	0	581	1.0	1,458	1.7
Social behavioural & Communications	0	0	777	1.3	5,821	6.7
Commerce	15,371	30.5	18,982	32.7	23,428	26.9
Natural Sciences	0	0	1,456	2.5	1,890	2.2
Computer	533	1.1	770	1.3	4,639	5.3
Medical & Health	2,497	4.9	4,919	8.5	6,937	8.0
Industrial trades & crafts	19,995	39.6	14,839	25.5	10,256	11.8
Engineering	427	0.8	4,633	8.0	3,051	3.5
Architecture & Town planning	0	0.0	217	0.4	2,023	2.3
Agriculture/forestry/Fish	4,267	8.5	3,234	5.6	4,129	4.7
Home economics/garden	95	0.2	114	0.2	0	0
Transport/Communications	316	0.6	349	0.6	422	0.5
Service trades	882	1.7	3,548	6.1	6,599	7.6
Mass communications	49	0.1	116	0.2	1,236	1.4
Sport & recreation	0	0	189	0.3	1,715	2.0
General pre-employment	3,124	6.2	890	1.5	852	1.0
Literacy and numeracy	0	0.0	0	0	1,363	1.6
Law	382	0.8	Na		1,547	1.8
Other	2,207	4.4	312	0.5	1,160	1.3
Total	50,457	100.0	58,083	100.0	87,117	100.0

Source: *Education statistics of New Zealand*

Table 7: Revenue of Polytechnics 2001

	$000	%
Government	351,649	56.8
Fees NZ	64,525	10.4
Fees International	45,967	7.4
Research	152	-
Other	56656	9.2
All	618,948	100.0

Source: Annual reports of Polytechnics

One final aspect of the changes that have occurred during the 1990 has been the increasing dependence of the polytechnics on private sources of income. In the 1980s the vast bulk of funding for the polytechnics came from the government. By the early 2000s this situation had changed considerably. During the course of the 1990s the government funding of polytechnics fell as denoted in constant dollar terms (see Figure 1). Real growth of government grants to the polytechnics also lagged behind that of growth in student enrolments (see Figure 2). This meant that the polytechnics became more reliant of funding from private sources such as student fees and fees for services provided. From Table 7 it can be seen that by 2001 almost a half of polytechnic funding came from non-government sources. One aspect of this process was the growth of income derived from full fee paying international students. In 1991 there were only 522 international students enrolled in New Zealand's polytechnics. By 2002 this figure had climbed to 6,899 (see Table 5). In 2001 5 per cent of enrolments in New Zealand polytechnics are overseas student who contribute seven per cent of those institution's income.

Overall the competitive climate in which New Zealand' polytechnics operate has been intensified throughout the 1990s. This has meant that they have been brought under more intensified pressure both to directly meet the demands of students and operate at a greater level of efficiency. In the next section we investigate the degree to which the New Zealand polytechnics have been able to improve their level of efficiency throughout the 1990s.

Economic Efficiency and Productivity of the New Zealand Polytechnics

Opening up the polytechnic sector to competition had a number of implications for the manner in which these institutions were managed. In particular it brought considerable pressure on them to operate at higher levels of efficiency. Government organisations such as tertiary education institutions often operate in markets where prices and costs are distorted by regulations, subsidies and the exercise of market power. This can make it difficult to use the normal market indicators of performance like profitability, and rates of return cannot be used accurately to gauge an institution's economic performance. Despite this problem governments and the general public are still concerned that these institutions operate in an efficient manner. Even without accurate costs and prices it is still possible to evaluate the efficiency and productivity performance of a group of similar institutions by using data on inputs and outputs to analyse technical and scale efficiency as well as technological progress and productivity change. The maximisation of output subject to a fixed budget is a central objective of education institutions (see Coelli *et al.* 1998, pp. 22-23). Moreover, Pestieau and Tulkens (1993) argue that productive (technical) efficiency is probably the only meaningful measure of the performance of public enterprises. Accordingly, the focus in this section of the paper is on the measurement of the levels of efficiency and productivity growth of New Zealand polytechnics during the 1990s in order to determine the extent to which the changes that have occurred have influenced their management. Stochastic Frontier Analysis (SFA) and Data Envelopment Analysis (DEA) are used to model the education production process, allowing for inefficiency, and offering information on changes in efficiency and technical change for the period 1995 to 2002.

The Malmquist DEA approach uses panel data to estimate changes in technical efficiency, technological progress and total factor productivity. The Malmquist DEA approach has been used in the past in a variety of circumstances such as financial institutions (see for instance Worthington

1999; Berg *et al.* 1992; Fukuyama 1995), electricity utilities (Fare *et al.* 1990; Hjalmarasson and Veiderpass 1992), gas utilities (Price and Weyman-Jones 1996) and hospitals (Fare *et al.* 1993). A recent paper by Färe, Grosskopf and Margaritis (2001) on productivity trends in Australian and New Zealand manufacturing give a good account of this approach. The only previous application of DEA to New Zealand polytechnics is that of Abbott and Doucouliagos (2000), who only explored two years of data. The DEA method used is discussed fully in Färe, Grosskopf, Norris and Zhang (1994).

The idea behind efficiency analysis is to use data collected for polytechnics to derive the 'best practice frontier'. What constitutes a best practice frontier can obviously change over time, therefore it is important to incorporate this aspect of the production process. The Malmquist DEA approach to calculating a total factor productivity index is one method of doing so. In effect, the Malmquist DEA approach derives an efficiency measure for one year relative to the prior year, while allowing the best practice frontier to shift. Logically, the frontier may shift outwards due to technological progress, or shift inwards to reflect technological regression. With DEA best practice institutions are given a ranking of 1 and efficiency scores are assigned to others by comparing them to best practice institutions.[4]

DEA has the advantage of being a non-parametric technique, and avoids the need to make assumptions regarding the functional form of the best practice frontier (e.g. Cobb-Douglas or translog). It also avoids the need to make distributional assumptions regarding the residuals in the regression analysis. There are some limitations with using DEA. It is important to note that DEA will always identify at least one DMU as being best practice. However, within any sample it is possible that all organisations will be inefficient to some degree. Thus, the technical efficiency scores derived from DEA are best seen as relative technical efficiency scores – the technical efficiency of an institution relative to what is identified as the best practice institution. An additional issue is that DEA is a non-parametric technique. Hence, it is not possible to undertake tests of statistical significance with DEA scores, in the same way as are conducted with regression analysis.

An alternative to DEA is the use of stochastic production frontiers (see Coelli *et al.* 1998). These are parametric techniques specifying the association between output and inputs. We find the stochastic production frontier preferable in that it offers valuable information on output elasticities, enables statistical testing of the parameters and is has solid underlying economic theoretical derivations. Hence, most of the focus in this paper will be on the SFA results.

Data and Specification

An important issue concerns the choice and quality of inputs and output. The common practice is to include only those inputs managers control to derive efficiency scores, and then to use information on the non-included inputs to assess if these inputs impact on the efficiency scores. Typically, however, detailed data on all inputs is not available. Ideally, data is needed on non-physical inputs, such as experience, information and supervision. Most importantly, there is the issue of the quality of the output. In the case of the polytechnics focusing on outputs (number of students enrolled or graduating) without considering the quality of education provided can bias the

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[4] DEA was pioneered by Charnes *et al.* (1978) who were in turn influenced by Farrell (1957) (see, for example, Charnes, Cooper, Lewin, and Seiford (1994), Lovell and Schmidt (1988), Färe, Grosskopf and Lovell (1985) and Coelli, Rao and Battese (1998)).

efficiency scores in favour of high output and low quality institutions (if they exist). A lack of quality-adjusted data for output levels necessitates the abstraction from the issue of quality.

The estimates of total factor productivity presented in this paper are based on three inputs and one output. The one output used is the number of students (EFTS) serviced by each institution and the three inputs are the number of academic staff, the number of general staff and the real value of fixed assets which is used as a proxy for capital stock. It should be noted that the data available in the Annual Reports is limited. For example, data on aggregate hours worked by teaching and non-teaching staff are not available.

The data used is a balanced panel, of 20 polytechnics for the period 1995 to 2002. These are: Aoraki, Auckland, Bay of Plenty, Christchurch, Eastern (Hawkes Bay), Wellington (CIT, Hutt Valley), UCOL (Manawatu), Manukua, Nelson-Marlborough, Northland, Otago, Southland, Tai Poutini, Tairawhiti, Western (Taranaki), Telford Rural, UNITEC, Wairariki, Waikato, Whitireia. The Auckland University of Technology is included in the data even after its conversion to a university in 1999. Means of the key variables used in the empirical analysis are presented in Table 8.

Table 8: Summary Data for New Zealand Polytechnics 1995 – 2002, Annual Means.

Variable	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Students EFTS	2,453	2,561	2,673	2,879	2,903	3,042	3,538	4,041
Academic Staff	197	209	203	206	209	216	235	248
General Staff	131	137	144	151	157	158	171	186
Fixed Assets $m	27,067	28,944	33,340	36,349	35,906	37,973	40,278	41,498
Students EFTS/Academic Staff	12.5	12.3	13.2	14.0	13.9	14.1	15.1	16.3
Students EFTS/General Staff	18.7	18.7	18.6	19.1	18.5	19.3	19.3	20.7

Unlike DEA, SFA requires a functional form to be specified. In this paper, a constant returns to scale specification is adopted so that the impact of changes in scale on output-to-input ratios is eliminated. The translog version of the constant returns to scale SFA is given by:

$$\ln(Q_{it}/K_{it}) = {}_0 + {}_1\ln(A_{it}/K_{it}) + {}_2\ln(G_{it}/K_{it}) + {}_3t + 1/2[{}_4\ln(A_{it}/K_{it})^2 + {}_5\ln(G_{it}/K_{it})^2 + {}_6t^2] + {}_7\ln(A_{it}/K_{it})\cdot\ln(G_{it}/K_{it}) + {}_8\ln(A_{it}/K_{it})\cdot t + {}_9\ln(G_{it}/K_{it})\cdot t + (u_{it} - v_{it}) \quad (1)$$

where ln denotes the natural logarithmic transformation, Q_{it} denotes the output (the number of students EFT) of polytechnic i and time period t, K denotes the real value of fixed assets, A is the number of full-time academic staff, G is the number of full-time general staff, t is a linear time trend, u is the random error term and v is a term for inefficiency. u is a two-sided symmetric random disturbance term (assumed to be iid $N(0,\square_u^2)$) while v is non-negative. In order to separate inefficiency it is necessary to make assumptions regarding the distribution of v. For example, v may be assumed to follow a truncated normal distribution or a half-normal distribution. For an excellent discussion on these issues, as well as the estimation of equation 1 by maximum likelihood techniques see Coelli *et al.* (1998). The results presented in this paper are based on the truncated normal distribution.[5]

In addition to the full translog specification, we estimate also a Hicks neutral technical change version of the stochastic frontier. If technical change is not biased against the use of any input, then technical change is said to be Hicks neutral. This can be imposed by restricting the input and time interactive terms to zero (that is, imposing $\_{8}= \_{9}=0$) yielding:

$$\ln(Q_{it}/K_{it}) = \_{0} + \_{1}\ln(A_{it}/K_{it}) + \_{2}\ln(G_{it}/K_{it}) + \_{3}t + 1/2[\_{4}\ln(A_{it}/K_{it})^2 + \_{5}\ln(G_{it}/K_{it})^2 + \_{6}t^2] + \_{7}\ln(A_{it}/K_{it})\cdot\ln(G_{it}/K_{it}) + (u_{it} - v_{it}) \quad (2)$$

An additional alternative specification is the Cobb-Douglas which arises when $\_{4}= \_{5}=\_{6}= \_{7}= \_{8}= \_{9}=0$:

$$\ln(Q_{it}/K_{it}) = \_{0} + \_{1}\ln(A_{it}/K_{it}) + \_{2}\ln(G_{it}/K_{it}) + \_{3}t + (u_{it} - v_{it}) \quad (3)$$

Equations 1, 2 and 3 were estimated using Frontier version 4.1 (see Coelli 1996). The coefficients of the estimated frontiers are presented in Table 9. The input and time interactive terms are not statistically significant (column 4, Table 9). Moreover, the elasticity of output with respect to technical change is an implausible negative with the full translog specification. A log-likelihood test of the validity of the Hicks neutral assumption over the Cobb-Douglas indicates that the Cobb-Douglas restriction is rejected. Note also that the squared terms are all individually statistically significant. Thus, we conclude that the education process in New Zealand's polytechnics can be modelled best through a constant returns to scale, Hicks neutral translog specification. This is used for the subsequent performance analysis.

In addition to functional form, it is important to test the existence of inefficiency in the education production process. Inefficiency in the education production process can be explored through generalized log-likelihood tests, testing the Null hypothesis of an average response function as opposed to a stochastic frontier.[6] This requires comparing the maximum-likelihood results to those derived from OLS. This is denoted as the LR Test in Table 9.[7] The hypothesis that the inefficiency effects are not random is tested by H_o: $\_=0$.[8] The results indicate that for this data set there is inefficiency in the production process and that a stochastic frontier should be used. For this dataset, OLS is not the preferred estimation. Gamma takes on values from zero to 1. It is clear from the size of _ (0.44) that the variance of the technical inefficiency effects is moderate. That is, a significant proportion, but not all, of the residual variation can be attributed to technical efficiency, rather than, for example, due to accidents and random mistakes in the education production process.

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[5] Results using the more restrictive half-normal distribution are available from the authors. These are similar to the results presented in the text.

[6] An average response function implies no inefficiency and can be estimated using OLS.

[7] Critical values for tests that involve the parameter □are found in Kodde and Palm (1986).

[8] The terms u and v are assumed to be independent of each other. The u are assumed to be iid $N(0,\square_u^2)$, and v is assumed to be independently distributed as truncations at zero of $N(TE_i,\square_v^2)$). We can then calculate gamma as $\square=\square_v^2/(\square_u^2+\square_v^2)$.

The coefficient on general labour is positive, while the coefficient on academic labour is negative (column 3, Table 9). Similar signs are found on the labour interactive terms. indicating that the returns from academic labour are declining as more academic labour is used, while the returns from general labour are increasing as more of that labour is used. The coefficient on the academic and general labour interactive term is positive, confirming that the two labour inputs are compliments in the production process. That is, the contributions of one labour input rise as usage of the other input increases. The time square term is positive indicating that technical change is proceeding at an increasing rate.

Table 9: Stochastic Education Production Frontiers, New Zealand Polytechnics

Variable	**Cobb-Douglas**	**Translog Neutral Technical Change**	**Translog**
Constant	2.005 (8.23)	7.16 (6.93)	-0.18 (-0.61)
Academic Labour	0.509 (7.52)	-1.61 (-1.93)	-0.09 (-1.51)
General Labour	0.333 (5.43)	4.41 (6.07)	-0.07 (-1.59)
Fixed Assets	0.158		-
Time	0.021 (1.70)	-0.002 (-0.09)	-0.12 (-1.36)
Academic Labour Square	-	-0.42 (-3.09)	-0.04 (-1.98)
General Labour Square	-	0.21 (1.69)	-0.03 (-1.47)
Fixed Assets Square	-		
Time Square	-	0.01 (2.33)	0.02 (4.15)
Academic * General	-	0.40 (1.82)	-0.02 (-0.66)
Academic Labour*time	-	-	0.00 (0.02)
General Labour*time	-	-	0.02 (0.83)
$\_^2$	0.027 (6.94)	0.03 (2.92)	0.02 (7.98)
_	0.112 (1.34)	0.44 (2.25)	0.01 (0.99)
LR test	14.79	27.59	29.88

The parameter estimates reported in Table 9 can be used to calculate the responsiveness of the number of students (EFT) to changes in factor inputs. These elasticities of output with respect to the three inputs and technical change (time) are presented in Table 10. The elasticities derived from the Cobb-Douglas differ to those derived from the Translog specification. The output elasticities for fixed assets and time are both twice as large in the translog specification, and the output elasticities with respect to labour are smaller.

Table 10: Output Elasticities, New Zealand Polytechnics

Input	**Output Elasticity Cobb-Douglas**	**Output Elasticity Hicks Neutral Translog**
Academic Labour	0.51	0.47
General Labour	0.33	0.22
Fixed Assets	0.16	0.32
Time	0.02	0.05

The technical efficiency levels associated with SFA for selected years are presented in Table 11.[9] The identity of the polytechnics is not revealed. For comparison purposes, the final column presents the technical efficiency levels when the Malmquist DEA is used. Several features of efficiency can be seen from Table 11:

- Disappointingly, the level of efficiency deteriorated in all of the polytechnics, for each year.
- If we take any polytechnic with a score of 0.95 or more as fully technically efficient, in 2002 there were no polytechnics on the frontier, compared to two in 1995.
- When there is inefficiency in the education production process, it is possible to increase output with the same level of inputs. In 1995, New Zealand's polytechnics could have achieved, on average, a 15 percent increase in output with the same level of inputs. By 2002, a 22 percent gain could be have been attained on average. This foregone output is the cost of inefficiency.
- The DEA results are very different, with eight polytechnics scoring 1, and most of the others effectively on the frontier. Even though the correlation between the SFA and DEA scores is 0.37, and is statistically significant, the results are qualitatively different. That difference can be attributed to DEA determining the best practice with the rest to the available peers (some decision making units will always be given a score of 1 with DEA). SFA, on the other hand determines the frontier without necessarily assigning any of the polytechnics to be on the frontier. For this dataset, it appears that DEA is not as useful as SFA.

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[9] The efficiency of polytechnic is calculated as exp($-v_i$).

Table 11: Technical Inefficiency in New Zealand Polytechnics, Translog Education Production Function

Polytechnic	1995	1997	1999	2002	2002 DEA
1	0.96	0.96	0.95	0.94	1.00
2	0.91	0.90	0.89	0.87	1.00
3	0.87	0.85	0.83	0.80	0.98
4	0.79	0.77	0.75	0.70	0.97
5	0.92	0.91	0.90	0.89	0.98
6	0.82	0.80	0.78	0.74	0.98
7	0.84	0.82	0.80	0.77	1.00
8	0.91	0.90	0.89	0.86	1.00
9	0.84	0.82	0.80	0.76	0.96
10	0.85	0.83	0.81	0.78	0.94
11	0.79	0.77	0.75	0.70	0.95
12	0.82	0.80	0.77	0.73	0.99
13	0.95	0.95	0.94	0.93	1.00
14	0.87	0.86	0.84	0.81	0.99
15	0.81	0.79	0.76	0.72	0.93
16	0.92	0.91	0.90	0.89	1.00
17	0.94	0.93	0.93	0.91	1.00
18	0.90	0.88	0.87	0.85	0.97
19	0.80	0.78	0.75	0.71	0.97
20	0.85	0.83	0.81	0.78	1.00
Average	**0.87**	**0.85**	**0.84**	**0.82**	**0.98**

Total factor productivity is the product of the technical change parameters from Table 9 and the change in the technical efficiency scores. The total factor productivity movements can then be converted into a cumulative total factor productivity index. The results of this procedure are presented in Table 12. Table 12 shows that the cumulative technical change was, on average, 30% over the 1995 to 2002 period. Since efficiency levels fell in each of the years studied, total factor productivity in the polytechnics was driven purely by technical change. If technical efficiency had improved over time (rather than deteriorating), so that each of the polytechnics became fully technically efficient by 2002, the average cumulative total factor productivity would have been 63%.[10] That is, total factor productivity would have been 25% higher if New Zealand's polytechnics became technically efficient.

[10] This was calculated by increasing efficiency for each polytechnic at a constant annual rate, so that by 2002 they each had a technical efficiency score of 1.0.

Table 12: Total Factor Productivity Indices, New Zealand Polytechnics

Polytechnic	1995	1997	1999	2002
1	1.00	1.04	1.13	1.38
2	1.00	1.03	1.11	1.34
3	1.00	1.02	1.08	1.29
4	1.00	1.02	1.08	1.25
5	1.00	1.03	1.11	1.36
6	1.00	1.02	1.08	1.27
7	1.00	1.02	1.08	1.29
8	1.00	1.03	1.11	1.33
9	1.00	1.02	1.08	1.27
10	1.00	1.02	1.08	1.29
11	1.00	1.02	1.08	1.25
12	1.00	1.02	1.07	1.25
13	1.00	1.04	1.12	1.38
14	1.00	1.03	1.10	1.31
15	1.00	1.02	1.07	1.25
16	1.00	1.03	1.11	1.36
17	1.00	1.03	1.12	1.36
18	1.00	1.02	1.10	1.33
19	1.00	1.02	1.07	1.25
20	1.00	1.02	1.08	1.29
Average	1.00	1.02	1.09	1.30

Summary

A number of very broad conclusions can be made from this study of New Zealand's tertiary education and training sector. First of all it should be recognised that the various institutions throughout New Zealand history have had to respond to some degree to the demands of students, employers and the community in general. The pressures of market forces have always been a reality and have had a considerable influence on the structure of tertiary education and training in New Zealand. This is not to deny that government policy and funding have also has a considerable impact of the manner in which education and training is provided in New Zealand. Since the beginning of the twentieth century governments in New Zealand have taken a very keen interest in the development of the education and training of the workforce. The early structure of training in the technical colleges and schools for instance illustrates the importance of both government intervention and its interaction with market forces. In the first half of the twentieth century demand by employers for workers for formal skills was not strong and could be catered for mainly through the provision of part-time courses in the technical schools and colleges. These courses concentrated on the building trades and commercial subjects, as the level of industrialisation of the New Zealand economy was relatively unadvanced. In the post-war period growing numbers in industrial based courses led to the establishment of the technical institutes. Although the government provides the institutional setting and much of the funding, it was the demands of industry that ultimately determined the size and nature of the technical colleges and technical institutes.

In more recent years market pressures have had an even more profound influence on the nature of the way the tertiary education institutions operate in New Zealand. This is true both in terms of the way in which the polytechnics operate and also in term because of the rise in importance of private education and training providers. The latter both caters for the demands of students that are not being met by the government sector and at the same time put pressure on the government sector to improve its performance in terms of efficiency and productivity.

Although considerable improvements have been made in the provision of tertiary education and training sector in New Zealand both in terms of it sheer size and diversity the last section of the paper indicates that there is still further scope for improvement on the part of the government owned sector in New Zealand in term of efficiency. The empirical analysis of the 20 polytechnics studied in this paper, over an important period (1995 to 2002) reveals divergent paths. On the one hand, technical change in the polytechnics has been impressive, roughly 5 percent per annum. The impact of technical change however was partly offset by deterioration in technical efficiency. The net effect however has been a 30 percent cumulative increase in total factor productivity, on average. A key research and policy issue arising from this is the reasons for the across the board deterioration in efficiency. Improving technical efficiency has important implications for cost of program delivery. The results presented in this paper indicate that in 2002 the polytechnics could have serviced around 22 percent more students, on average, with the same level of input usage. Thus, it becomes imperative to explore the factors that have led to deterioration in efficiency. Improved efficiency would, as indicated previously, increase the already solid growth in total factor productivity.

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[1] At the same time that these four universities (Auckland, Otago, Canterbury and Victoria) were established the States of New South Wales and Victoria in Australia possessed only two universities each, despite having populations of a similar size to New Zealand's.

[2] The reports on education and training were the Probine-Fargher report on polytechnics (1987), the Shallcrass Report on non-formal education, (1987), the Treasury briefing paper (1987), the Watts report on Universities (1987), the Tertiary Review (Report on Submissions to the Tertiary Reviews, 1988), and the Picot Report on educational administration (1988).