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LIBERALISATION OF TECHNICAL EDUCATION IN KERALA: HAS A SIGNIFICANT INCREASE IN ENROLMENT TRANSLATED INTO INCREASE IN SUPPLY OF ENGINEERS?

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ABSTRACT

There has been a significant increase in the places for undergraduate engineering degree programmes in the state. This has happened over the last decade by licensing a number of privately owned engineering colleges. Consequently, enrolments in engineering increased from about 2800 in 1991 to about 28,000 in 2008. The study analyses whether this increase in potential supply of engineers has resulted in actual supply of engineers. In fact, after a careful analysis of a unique data set the study reaches the conclusion that actual outturn rates have been steadily declining and especially since 2004. This decline is observed both at the aggregate level, across different branches and across different colleges. It then hypothesises about the probable causes for this steady decline in outturn rates and has identified this in terms of two prominent causes. The study then concludes with the larger implications of this state of affairs.

Keywords: technical education, engineering education, pass rates, outturn rates, privatisation, self-financing colleges, TEQIP, educational loans, Kerala.

JEL Classification: I23; 128; O30

Introduction

Economic liberalisation in 1990s gave major impetus to the Indian software services industry. It grew dramatically from the mid 90s and continued to show significant growth performance until it was adversely affected by the global financial crisis of 2008-09. India gained a comparative advantage in this industry through its low labour cost. Firms took advantage of availability of trained human resource in the country to provide software services for other countries. Fuelled by domestic human resource and raise in demand for software services in the USA and Europe from the late 80s, software service emerged as a success of economic liberalisation. As industry grew, labour supply became a major challenge. It is generally accepted in both industry and policy circles that technical education system in India was not supplying enough human resource to the labour market. The same all -India pattern could be found across the states and even for a state like Kerala which had just begun to make a presence, albeit, small in the IT services sector. Late 1990's saw a significant growth in software exports from Kerala. Given the extreme shortage of trained engineers in the disciplines related to computer science, the IT services firms were prepared to recruit engineers of any discipline and then subject them to in-company training as a way of equipping them for the growing service contracts that these companies were receiving. Very soon this recruit strategy

came to a grinding halt. Given the sudden surge in the demand for engineering graduates coupled with limited enrolment possibilities for the same, students were forced to migrate to especially engineering colleges of the self-financing type located elsewhere.

Engineering education in the state was essentially public funded and provided, right through from the beginning and until 2001. Most of them were government owned, although there existed a small number of government aided private engineering colleges which were also, by and large, subjected to the same enrolment policy as far as student admissions were concerned. Considering the inability of the state to invest further in technical education, and given the growing demand for engineering graduates even from within the state, liberalisation of technical education became an inevitable choice. This led to the liberalisation of technical education from 2001 or so, which dramatically increased the number of engineering colleges in the state. One argument that was furthered during the period was that by allowing private investment in technical education in a self-financing mode will reverse the capital flight from Kerala.

There is a tendency on the part of commentators, both industry and otherwise, to use this increased capacity of technical education institutions as an indicator of expanding human resource supply in the state. There exists a fair amount of confusion between enrolment and actual supply of engineers. The present study is a modest attempt to correct this distortion in our understanding by systematically working out the trends in actual supply of engineers from the engineering colleges in Kerala. It is based on the data compiled by the National Technical Manpower Information Systems (NTMIS) supplemented with data on enrolments and actual outturns from one of the leading the oldest leading universities in Kerala, namely the University of Kerala. It must, however, be stated at the very outset that the NTMIS is not upto date with its data. For the state of Kerala, the latest available outturn rates can be computed for the 2004 cohort of undergraduate students in engineering passing

out in 2008[1]. Actual outturn rates computed with this data for 1991 through 2004 cohorts of students enrolling for undergraduate engineering courses in the state show that outturn rates have actually come down significantly and a branch-wide analysis shows that there has been a significant reduction in the rate of outturn in the more popular branches. It is very evident that the expansion in capacity of undergraduate education has not led to improvements in supply. This state of affairs have precipitated a serious public debate in the state, questioning the policy of liberalisation which it appears does not seem to have improved the quantity to the desired extent, while at the same time appeared to have a deleterious effect on the quality of engineers produced within the state. The only consolation perhaps is that the problems that are alleged to have been brought about by liberalisation of technical education is not restricted to Kerala alone, but explicit reverberations of this could be found in other states as well. In short, the effect of liberalisation on technical education and its likely effects on both the quantity and quality of engineers in the country is a key policy challenge faced both at the central and state levels.

The choice of the Kerala situation as a specific case for in-depth examination is justified because Kerala has one of the largest number of seats for undergraduate courses in engineering, especially when it is related to its population: Kerala's share in the total intake for undergraduate engineering studies account for about 5 per cent, and this intake in 2008-09 has increased by about 5 times the intake two decades earlier in 1990-91(See Annexure 1).

Given the above scenario, the paper is structured into six sections. The section first maps out the outturn rates of engineers, both at the aggregate and across various engineering branches for the state as a

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1 See the website of the NTMIS nodal centre for Kerala located at the Cochin University of Science and Technology, http://nodalcentre.cusat.ac.in/ (accessed on March 21, 2008).

whole. This macro picture on outturn rates is further supplemented with those obtained at the micro level from one of the universities in Kerala. This micro picture further brings out in a clear manner the effect of self-financing colleges on the outturn of engineering graduates. This forms the focus of the second section. The third section speculates on the possible reasons for this state of affairs, observed both at the macro and micro levels. The fourth section discusses the interventions by the state towards reversing this trend. The fifth section delves into the implications of the declining outturn rates and the sixth section sums up the main findings of the study.

I. Outturn of engineering graduates at the macro level

Courses in engineering have emerged as one of the most preferred options for students passing out of the secondary school system. This higher demand to a great extent is influenced by the increasing demand for engineers in a rapidly growing economy. This is reflected in the ever increasing average salaries of graduate engineers most of whom get absorbed in one of the fastest growing industries in the country, namely the IT services industry. In response to this growing demand there has been a tremendous increase in the capacity and actual intake of places for engineering in the state. See Table 1.

It is seen that the real growth in capacity and intake started from around the end of the 1990s and continued all through the last decade. Another interesting fact is that although sanctioned intake and actual intake were moving in tandem until 2001 or so, the two started diverging from each other from around 2002 onwards until 2006 or so with actual intake being considerably less than the sanctioned one. Once again, since 2006 onwards the two have started moving in tandem. A significant increase in the number of engineering colleges happened in 2002 when 29 new colleges were sanctioned during that year. Almost all these new colleges are in the private sector and they are usually referred to as self-financing colleges as they do not receive any grants from the state but

Table 1: Trends in Number of engineering colleges, sanctioned and actual intake (in numbers)

	Number of engineering colleges	Intake	
		Sanctioned	Actual
1991	9	2810	2795
1995	16	3930	4441
1996	17	4699	4657
1997	17	4871	4792
1998	17	4979	5122
1999	24	6668	6126
2000	33	8820	8739
2001	45	11293	11147
2002	74	18280	16143
2003	81	19889	16563
2004	87	23643	16837
2005	91	24526	21857
2006	91	26349	25471
2007	91	28578	27975
2008	94	30069	29635
2011	142	45147	NA

Source: NTMIS nodal centre for Kerala (various issues), Kerala State Planning Board (2012)

their main income is free increased fees and donations of various kinds, charged from prospective students. In fact, their arrival has been the subject of a virulent debate on the consequences of privatisation of education and its repercussions on quality of instruction etc. Often enough, this debate had violent overtones. In fact, the arrival of these self-financing colleges although has increased the capacity of engineering education in the state, has also at the same time, brought to the fore, serious deficiencies in the higher education scene in Kerala. Although the colleges are distributed across all the 14 districts of the

state, approximately half of them are located in the three districts of Trivandrum, Kollam and Ernakulam. Approximately 50 per cent of the colleges are affiliated to two of the universities, namely, University of Kerala and Mahatma Gandhi University.

An analysis of the branch-wide actual intake presents an interesting picture. See Table 2. Although there are 19 branches now, five branches (Electronics and Communication, Computer Science and Engineering, Mechanical, Electrical and Electronics and Information Technology) accounted for about 75 per cent of the intake in 2007. However, in 1991 the top 5 branches (Electrical and Electronics, Mechanical, Civil, Electronics and Communication and Computer Science and Engineering) accounted for about 85 per cent of the intake. Interestingly, the concentration has come down with the emergence of a number of new branches, Information Technology being one of the newest branches.

Traditional branches such as Electrical and Electronics, Civil and Mechanical has gone considerably down in student preferences. Electronics and Communication, Computer Science and Engineering and Information Technology have taken up the share vacated by these three. In fact, Electronics and Communication has become the most preferred branch although the fastest growth rate is in Information Technology. However, irrespective of the branch, most of the students graduating have been finding jobs in the IT services space where their previous training or background has become irrelevant.

We understand that the more recent intake data shows a slightly different picture with the traditional branches gaining in importance. Student choices seem to be dictated more by the perceived demands from the labour market and these are individual choices, which may not be faulted upon. A natural correction for this distortion is bound to happen in the long run, although in the short run, such a lopsided structure may prevail.

Table 2: Changes in branch-wide intake: 1991 and 2007

Branch	1991(in numbers)	Share (%)	2007 (in numbers)	Share (%)
Agriculture Engineering	0	0	39	0.14
Applied Electronics & Instrumentation	45	1.61	1078	3.95
Architecture	75	2.68	157	0.58
Bio Medical	42	1.50	145	0.53
Chemical	78	2.79	215	0.79
Civil	584	20.89	2050	7.51
Computer Science Engineering	255	9.12	5603	20.52
Electrical & Electronics	580	20.75	4031	14.76
Electronics & Communication	375	13.42	6697	24.53
Electronics & Instrumentation	0	0	377	1.38
Industrial Engg	21	0.75	17	0.06
Information Technology	0	0	2674	9.79
Instrumentation & Control	32	1.14	120	0.44
Mechanical	581	20.79	3842	14.07
Naval Arch & Ship Building	28	1.00	35	0.13
Polymer Engg	0	0.00	26	0.10
Polymer Science & Rubber Technology	18	0.64	22	0.08
Production Engg	81	2.90	142	0.52
Safety & Fire Engg	0	0	32	0.12
Total	2795	100	27302	100

Source: NTMIS nodal centre for Kerala (various issues)

Intake has increased at an annual average rate of 17 per cent, while the outturn has increased only at 15 per cent per annum during the period 1995 through 2007. See Figure 1. Despite sharp increases in outturn since 2004, it is seen that the outturn has been on a declining

mode since 2006. In 2007, for instance, when the intake is about 24000 students, the actual number of engineers graduating is only about 9300. In discussions among policy makers and industrialists as well, there is a tendency to use intake or enrolment figures to speak about actual supply of engineers. This is really fallacious. Enrolments are only indicative of potential supply of engineers, while outturn is a more direct measure of the actual supply of engineers. In short, our analysis clearly shows us, that despite tremendous increases in enrolments or intake, the actual supply of engineers has been considerably less, owing to high failure rates and dropout rates. This issue has, of course, attracted considerable attention in the popular press. Privatisation of engineering education, although increasing enrolments, has actually led to deterioration in the quality of engineering education as indicated by lower outturns. However, in all fairness, this deterioration has actually started in the 1990s, when the provision of engineering education was still in the government

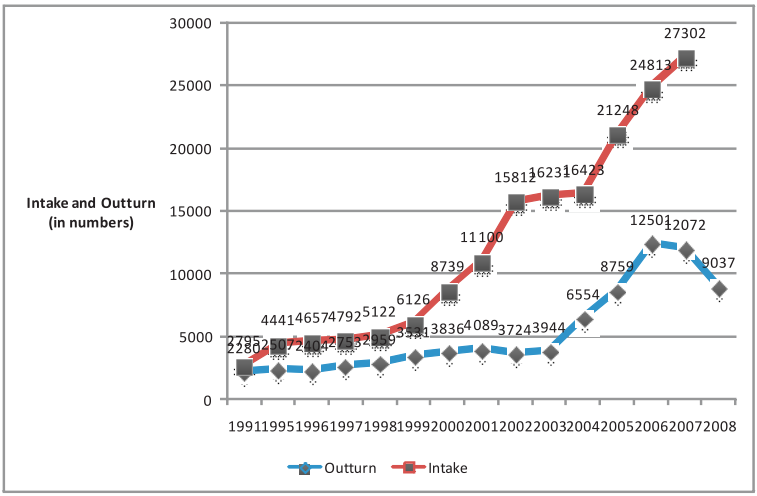

Figure 1: Trends in Intake and Outturn of Graduate Engineers, 1991-2008

Source: NTMIS nodal centre for Kerala (Various Issues)

sector. The fall in outturn, which had already started happening, has been accentuated with the so called privatisation.

We now turn our attention to the outturn rates. These rates measure the actual supply of engineers. Given the fact that undergraduate degrees in engineering in universities in Kerala (which of course follow the All India Council for Technical Education pattern) is four years in duration, outturn rate in year "t" is obtained by dividing the outturn in year "t' by the intake in year "t-4". In symbols:

$$OTR_t = (OT_t/IT_{t-4})*100$$

Employing the above formula, we have worked out the outturn rates both at the aggregate level (Figure 2) and at individual branches (Table 3). Given the four year time lag and the availability of data we are in a position to compute the outturn rates for the intakes in 1991 (graduating in 1995) through 2004 intake (graduating in 2008).

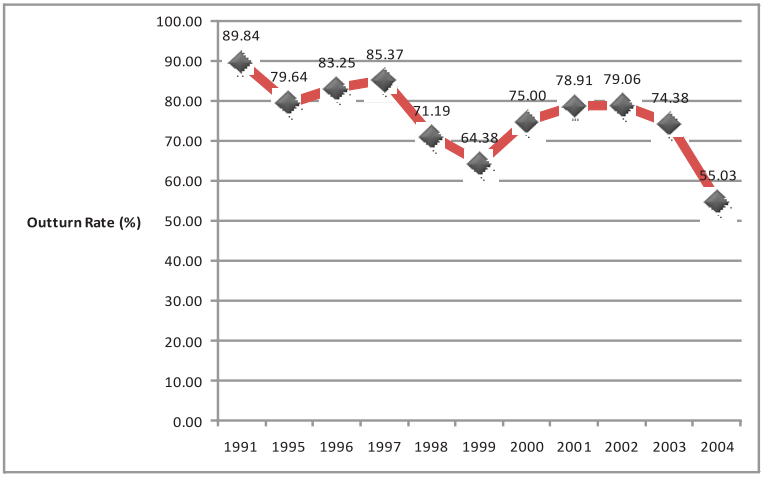

Figure 2: Outturn rates for engineering graduates in Kerala, 1991 intake through 2004 intake

Source: Computed from NTMIS nodal centre for Kerala (various issues)

This shows a rather alarming situation. The OTR, which was almost 90 per cent for the 1991 intake, has started coming down over the years, and currently stands at about 55 per cent. This means that currently, 1 out of every 2 students who join the four-year degree programme in engineering either drops out, or fails in the exams, resulting in low outturn rates. This has serious implications for the actual supply of engineers. Even more is the social cost of such large failures. We deal with this issue in some more detail in section V below.

How do these OTRs for Kerala compare with the all India pattern? This is not available for India as a whole, as the National Technical Manpower Information System (NTMIS) does not report this data. However, the Annual Technical Manpower Review (ATMR) does report this data for some of the states. Banerjee and Muley (2008) have compiled this data on OTRs for the available states which includes Kerala as well, but for the period 1991 through 2004. This is presented in Table 3. No clear trend is visible, excepting to say that the OTRs in Kerala compare favourably with the other states. West Bengal appears to have the best OTRs. However, it must be stated that the OTRs presented in this table does not tally with what we have presented in Figure 2 above, where these have been computed, employing the same methodology as Banerjee and Muley (2008). In specific terms, OTRs as computed by us is lower than OTRs computed by the latter authors. One explanation for the difference may be that Banerjee and Muley's estimates end with the 1998 intake (graduating in 2002), whereas our estimates refer to the intakes until 2004 (graduating in 2008).

We now analyse the OTRs at the disaggregated level- at the level of individual branches. See Table 4.

Table 3: Outturn Rates of Engineering graduates across states in India, 1992-2004 (in per cent)

State	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Karnataka	-	-	-	-	-	-	0.63	0.61	0.62	0.6	0.59	0.56	-
Tamilnadu	-	-	-	0.76	0.86	0.74	0.69	0.72	0.73	0.7	0.75	0.77	-
Maharashtra	-	-	-	-	-	-	-	-	-	-	-	1.11	-
Andhra Pradesh	-	-	-	-	-	-	-	0.97	0.94	0.93	0.75	-	-
Kerala	0.84	0.82	0.78	0.9	0.86	0.92	0.86	0.91	0.86	0.81	0.75	-	-
Delhi	-	-	-	-	-	-	-	0.94	0.9	0.82	0.74	0.64	0.57
West Bengal	-	-	-	-	-	1.01	1.01	1.02	1.01	1.06	0.88	-	-
Himachal Pradesh	-	-	-	-	-	-	-	-	-	0.66	0.82	0.78	0.61
Chandigarh	-	-	-	-	-	-	-	-	0.85	0.75	0.83	0.8	-
Orissa	-	-	-	-	-	-	-	-	-	-	-	0.89	0.98
Haryana	-	-	-	-	-	-	-	1.09	1.2	0.53	0.83	0.37	0.32
Assam	-	-	-	-	-	-	-	-	-	0.74	-	-	-
Gujarat	-	-	-	-	-	-	-	-	-	-	-	1.03	-

Source: Banerjee and Muley (2008), Table 1.4

Table 4: Trends in branch-wide OTRs, 1991 intake through 2004 intake

Branch	1991/1995	1995/1999	1996/2000	1997/2001	1998/2002	1999/2003	2000/2004	2001/2005	2002/2006	2003/2007	2004/2008
Applied Electronics & Instrumentation	97.78	97.12	2000.00	82.73	86.36	75.15	63.79	69.02	76.54	69.27	54.26
Architecture	86.67	57.50	75.95	40.00	68.87	30.05	44.00	77.27	108.65	82.00	54.55
Bio Medical	71.43	56.41	61.11	83.78	60.98	50.00	97.50	89.47	84.85	85.86	73.40
Chemical	94.87	71.95	77.11	83.15	64.08	75.17	75.35	87.32	84.00	94.52	77.40
Civil	89.21	69.94	76.10	77.47	65.86	59.46	74.67	81.85	88.10	76.31	65.38
Computer Science Engineering	82.75	78.01	87.52	89.62	71.45	64.84	77.38	78.07	81.07	75.04	57.62
Electrical & Electronics	88.97	85.15	87.65	80.43	76.65	70.01	79.89	79.84	85.55	71.10	61.32
Electronics & Communication	94.13	85.31	82.98	95.73	77.67	65.69	78.56	78.73	77.05	78.27	52.17
Electronics & Instrumentation							49.04	59.18	70.76	69.01	44.38
Industrial Engg	104.76	76.19	85.71	73.33	76.67	40.00	93.33	100.00	93.33	93.10	89.66
Information Technology	0.00	96.05	108.00	72.58	76.67	67.83	77.43	71.00	70.49	63.11	42.57
Instrumentation & Control	103.13	96.67	93.75	92.50	62.50	76.32	59.32	66.10	85.71	57.66	50.00
Mechanical	89.71	76.71	75.50	87.15	67.82	63.61	66.85	87.97	74.06	72.44	49.90
Naval Arch & Ship Building	100.00	96.55	100.00	68.97	100.00	71.43	100.00	72.41	56.76	52.63	57.89
Polymer Engg	0.00	0.00		103.77	78.85	51.35	138.89	181.25	190.63	0.00	38.46
Polymer Science & Rubber Technology	100.00	88.89	23.08	106.25	100.00	77.78	39.29	113.33	100.00	87.50	63.64
Production Engg	85.19	85.23	82.11	80.43	82.22	54.29	69.77	96.59	80.68	169.41	74.16
Safety & Fire Engg	0.00	0.00	100.00	83.33	62.96	31.03	54.05	56.67	93.33	96.67	60.00
Average	**89.84**	**79.64**	**83.25**	**85.37**	**71.19**	**64.38**	**75.00**	**78.91**	**79.06**	**74.38**	**55.03**

Source: Computed from NTMIS nodal centre for Kerala (various issues)

There has been an across the fall drop in outturn rates in all the 19 branches in 2004 compared to 1995. The fall has been rather heavy in some of the more popular branches of Electronics and Communication,

Table 5: Ratio of students failed to those who have passed (Based on the 2008 examination results)

	Ratio of students failed to those passed
Polymer Engineering	1.60
Automobile	1.59
Electronics & Instrumentation	1.45
Printing	1.38
Information Technology	1.18
Instrumentation & Control	1.14
Electronics & Communication	1.09
Naval Architecture & Ship Building	1.00
Mechanical	0.98
Computer Science	0.86
Safety & Fire Engineering	0.83
Applied Electronics & Instrumentation	0.82
Electrical & Electronics	0.79
Mechanical Production	0.79
Mechanical Automobile	0.68
Architecture	0.62
Civil	0.59
Marine Engineering	0.53
Polymer Science & Rubber Technology	0.50
Biotechnology	0.46
Biomedical	0.42
Chemical	0.36
Production Engineering	0.35
Instrumentation	0.19
Agriculture Engg	0.13
Industrial	0.08
Total	0.90

Source: Computed from NTMIS nodal centre for Kerala (2010)

Computer Science and Engineering and Information Technology. We also notice that the OTRs have started falling, with fluctuations, from the 1998 intake onwards and the worst results were obtained for the 2004 entry.

Results of the 2008 show also that on an average the students who failed, account for about 90 per cent of those who passed. See Table 5. In a number of popular branches the number of students who failed actually outnumber those who passed. Recent press reports and our subsequent micro level analysis lead us to believe that this trend is likely to continue in the future as well.

II. Outturn of engineering graduates at the micro level

The University of Kerala, established in 1937, is the oldest university in Kerala. The oldest engineering college in Kerala, the College of Engineering, Trivandrum is affiliated to this university. This section provides a micro level picture of engineering education in the state, with help of data on intake and outturn of engineers from engineering colleges affiliated to the University of Kerala. As of March 31 2011, 39 engineering colleges are affiliated to the University of Kerala.

Table 6: Intake and outturn of engineering graduates from University of Kerala

	No of Students		Annual Growth(%)		Outturn Rate according to year of intake
Year of intake	Intake	Outturn	Intake	Outturn	
2004	4486	2814			62.73
2005	5204	3092	16	10	59.42
2006	7286	2517	40	-19	34.55

Source: Public Relations Office, University of Kerala

The number of engineering colleges affiliated to the university started increasing after the liberalisation of engineering education in 2001. From 5 colleges in the pre liberalisation regime, the number of colleges increased to 16 by 2002. All the newly formed colleges have a self-financing model. 2009 also marks a sudden increase in engineering colleges affiliated to the university.

In terms of capacity and outturn rates, the data from Kerala University shows the same pattern seen in state level data. The intake and outturn for three cohort of students from 2004 to 2006 (Table 7), shows that while intake has grown fast, outturn rate has not increased at the same pace. The results for 2006 cohort show substantial reduction in outturn rate at 35 per cent. Even the absolute number of outturn for 2006 cohort is actually less than the absolute level of outturn for 2004 cohort.

An analysis of results of individual colleges helps to better understand the source of failure in outturn. Table 8 gives the pass percentage of individual colleges affiliated to Kerala University between 2006-2010. Based on their financing model, colleges are grouped into Government funded, Government aided, and Self Financing. It can be seen that Government funded and Government aided colleges have better pass percentage than self-financing colleges across the five years (Figure 3). While there is a drop in the pass percentage across all groups of colleges, it is much higher in the case of self-financing colleges. The difference between the pass percentage of self-financing and government/ aided colleges continued to increase during 2006-2010 and reached a stable level during the last three years. Two colleges from self-financing mode, which show relatively speaking, better results, are Mar Baselios College of Engineering and Technology and LBS Institute of Technology for Women. Of the two, LBS Institute of Technology for Women is under an autonomous government agency.

Table 7: Pass rates of individual engineering colleges affiliated to University of Kerala (In per cent)

Name of College	Year					Type of college
	2006	2007	2008	2009	2010	
College of Engineering, Thiruvananthapuram	87	85	73	74	73	Govt
Government Engineering College, Barton Hill, Thiruvananthapuram	81	75	66	64	65	Govt
S.C.T College of Engineering, Thiruvananthapuram	69	71	62	62	40	Self Financing
T.K.M.College of Engineering, Kollam	72	72	64	66	60	Aided
University College of Engineering, Kariavattom, Thiruvananthapuram	58	53	62	47	38	Self Financing
LBS Institute of Technology for Women, Thiruvananthapuram	77	75	58	77	54	Self Financing
Marian College of Engineering & Technology, Thiruvananthapuram	66	54	34	40	46	Self Financing
Mar Baselios College of Engineering & Technology, Nalanchira, Thiruvananthapuram	69	63	53	50	53	Self Financing
Mohandas College of Engineering & Technology, Thiruvananthapuram	70	57	42	48	34	Self Financing
Baselios Mathews II College of Engineering, Sasthamcotta, Kollam	39	30	15	19	22	Self Financing

Cont'd.....

Shahul Hameed Memorial College of Engineering, Kadakkal ,Kollam	52	27	14	19	9	Self Financing
Lourdes Matha College of Science & Technology, Thiruvananthapuram	61	40	23	33	34	Self Financing
Sree Buddha College of Engineering, Nooranad, Alappuzha	77	55	37	30	40	Self Financing
Muslim Association College of Engineering, Venjarammoodu, Thiruvananthapuram	58	39	24	16	21	Self Financing
Younus College of Engineering & Technology, Kollam	59	40	25	27	25	Self Financing
Travancore Engineering College, Oyoor, Kollam	57	30	16	17	16	Self Financing
PRS College of Engineering and Technology, Thiruvananthapuram	0	12	18	2	6	Self Financing
P. A. Azeez College of Engineering, Thiruvananthapuram	0	53	23	22	19	Self Financing

Source: Website of Kerala University Computer Centre, http://kucc.keralauniversity.edu/frntresultanalysis.asp (accessed on February 14, 2012)

There has been a significant drop in the pass percentage since 2008 (2004 cohort)[2]. This is attributed to the fact that before 2004, in 50% of the seats for engineering education, the government admitted candidates for a lower fee. As fee increased and control of admission went to managements of self-financing colleges, many students with capability came to be excluded from self-financing colleges. This is reflected in the lower pass percentage from 2008 onwards. Either the students who gained seats in self-financing educational institutions did not meet the basic requirement for technical education, or the newly formed institutions did not have the ability to train the students suitably.

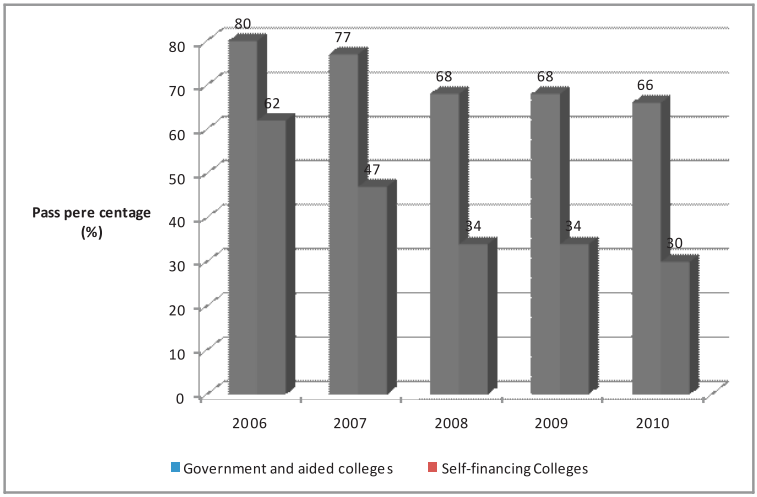

Figure 3: Pass percentages across government and self-financing colleges under the University of Kerala

Source: Based on data contained in Table 8

2. This finding at the individual college level corroborates what we observed at the aggregate level as well.

III. Some hypotheses for the decline in outturn rates

We have now presented quantitative evidence to show that the outturn rates have declined rather significantly for the state as a whole and at individual branches of engineering. This finding was further supported by a micro-level analysis of a leading university in the state. In specific terms we observed two major findings: (i) the outturn rates declined significantly since the intake of 2004; and (ii) the outturn rates for self-financing private sector colleges were considerably lower than government colleges. How does one explain this decline? We have a few conjectures in this regard. We divided them into two broad categories, namely: (i) decline in quality of instruction; and (ii) aptitude and capability of the students.

i. Quality of instruction

There is a general feeling that quality of instruction has declined steadily. This is in turn due to three separate but interrelated factors: (i) poor quality of faculty; (ii) an outdated syllabi (Banerjee and Muley, 2008); and (iii) substandard infrastructure (especially library, workshops and labs). We examine the first of these three, as we do not have much data on the latter two. In fact, in the case of the syllabi, the complaint is usually from the industry, and this is reflected in the low employability quotient discussed below. However, without the existence of objective indicators.

Quality of faculty: The number of technical institutions in India, imparting education and research skills in engineering and technology has risen to 1475 with an annual intake of nearly 5,00,00, according to the All India Council of Technical Education (2006). According to the AICTE, the approved intake for 2011-12 (at the undergraduate engineering level) is 10.66 lakhs.[3] Currently, based on the established

3. See the AICTE website: http://www.aicte-india.org/statistics.htm (accessed on March 21, 2012).

AICTE norms of student: teacher ratio (1:15) and the cadre ratio of 1:2:6 for Professors: Readers: Lecturers, the total shortage of teaching staff is over 40,000 and the shortage in the different cadres is Professors - 4531, Readers - 9063 and Lecturers - 27187. The shortage of Ph. D.s exceeds 30,000, while the Masters' shortfall is over 24,000. This is the picture for India as a whole, and the situation in Kerala is actually no better, or in some cases, even worse than the all India pattern (All India Council of Technical Education, 2006).

First of all, the most recent report, Annual Technical Education Review 2008 (NTMIS Nodal Centre for Kerala (2008)) reports of shortage of teachers: as against the sanctioned strength of 6982 teachers (as on March 31, 2008), there were only 6466 teachers on the rolls of the various engineering colleges leaving an uncovered gap of 516. The shortage is more acute in the popular branches of Electronics and Communication, Computer Science and Information Technology. Second, even most of the existing teachers have only a graduate degree themselves (Figure 4) and it is not immediately clear about their experience, although discussions have revealed that most of these graduate teachers are fresh hands with very little experience. In addition, the attrition rate among the teachers is as high as 30 per cent[4] as for most of them a teaching assignment is only a stop-gap arrangement till they find themselves a better employment in the industry where salary and conditions of work are far more attractive. This is especially so in the most popular branches.

4. There are no official estimates of the attrition rate. A recent newspaper report does provide some estimates. See Naha (2007), http://www.hindu.com/edu/2007/09/11/stories/2007091150020100.htm (accessed on February 16, 2012).

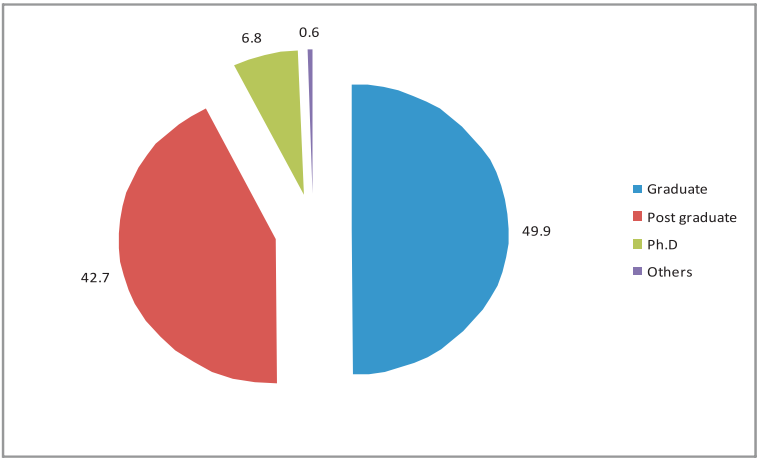

Figure 4: Distribution of teacher qualification in engineering colleges in Kerala (as on March 31, 2008)

Source: NTMIS nodal centre for Kerala (2010)

In order to quantify the effect of faculty qualification on results obtained, we did an exercise based on data from a sample of colleges under the University of Kerala. For this, we designed a "Faculty Qualification Index" which is defined as the weighted average of scores obtained based on the level of qualification (a score of 1 for just being a graduate teacher, a score of 2 in the case of a post graduate qualification and finally a score of 3 for having a doctoral degree). The index will range from 1 to 3 and the closer it is to 3, the better it is. Only one government, and one aided college, is able to cross the index of 2.0. Except for the two colleges from self-financing sector which could get a score of 1.9 all the others are close to 1.5. As the quality of teachers being an important factor that affects the results of students, we hypothesized a positive correlation between the index and the pass rates of colleges in the sense that colleges having a score closer to three have a higher pass rate and so on. The results of this exercise are reported in Table 8.

Table 8: Relationship between faculty qualification and pass percentage (2010)

College	Faculty qualification			Index of faculty qualification (1-3)	Pass Percentage (2010)
	PhD	MTech	BTech		
College of Engineering, Thiruvananthapuram	35	163	23	2.054	73
S.C.T College of Engineering, Thiruvananthapuram	2	46	39	1.575	40
T.K.M.College of Engineering, Kollam	27	75	20	2.057	60
LBS Institute of Technology for Women, Thiruvananthapuram	0	16	35	1.314	54
Marian College of Engineering & Technology, Thiruvananthapuram	4	29	52	1.435	46
Mar Baselios College of Engineering & Technology, Nalanchira, Thiruvananthapuram	1	87	9	1.918	53
Baselios Mathews II College of Engineering, Sasthamcotta, Kollam	2	49	48	1.535	22
Shahul Hameed Memorial College of Engineering, Kadakkal, Kollam	2	2	69	1.082	9
Lourdes Matha College of Science & Technology, Thiruvananthapuram	1	53	33	1.632	34
Sree Buddha College of Engineering, Nooranad, Alappuzha	3	68	14	1.871	40
Muslim Association College of Engineering, Venjarammoodu, Thiruvananthapuram	2	28	55	1.376	21
PRS College of Engineering and Technology, Thiruvananthapuram	2	22	48	1.361	6

Source: Own compilation

The zero-order correlation between faculty qualification index and pass percentage shows a statistically significant (at 1% level) positive correlation(r=.74 p=.0059). If we eliminate LBS college from the sample, the correlation coefficient increases (r=.87, p=.0005). What is unique to LBS is that, being under the government, it has faculty visiting from other government colleges on a special working arrangement which gives it access to highly qualified teachers. While this result supports the hypothesis, it should not be taken as evidence to prove that quality of teachers is what determine the results. We have not controlled for other factors like ability of students and infrastructure for the lack of data. It is also expected to happen that students with better ability having obtained higher ranks choose government and aided colleges for a lower fee and quality teacher.

Higher learning in technical education sector in Kerala is also affected by capacity problems. There are only a few seats for postgraduate level education in the state. Between 1991 and 2007, intake in graduate level courses in Kerala grew ten times (Table 9). In the same period, intake in the post graduation and diploma levels were increased only three times. Total intake in graduate level surpassed that of diploma level in 2001. This limits the supply of capable teachers in the immediate future also.

The only positive change that has happened lately is the improvement in the salary structure of staff of government engineering colleges. It has made academia a bit more attractive than earlier. When the quality of engineering institutions, which offer higher education, is low, it is unlikely that they can provide quality teachers for graduate level education. This poor quality, and in some cases even shortages of faculty, has been thrown up by a number of detailed university-wide inspection reports, done by the Department of Technical Education, on self-financing colleges under each of the five universities in the state.

Table 9: Student Intake Graduate, Post Graduate and Diploma levels

Course	Year								
	1991	2000	2001	2002	2003	2004	2005	2006	2007
Post Graduate	256	303	336	433	453	611	647	724	782
Graduate	2810	8820	11293	18280	19889	23643	24585	26349	28578
Diploma	4488	10140	10295	10350	10285	10435	10760	10853	12342

Source: NTMIS nodal centre for Kerala (2008)

Although the detailed reports are not available, abstracts of the reports[5] gives in a tabular form the situation with respect to each of the self-financing colleges with respect to the availability and quality of faculty. These further confirm the observations that we have made and it also shows that the government has enough quantitative evidence with it to take corrective actions.

The drawbacks of higher education in the state indicate that the technical education system in the state may not be able to address the need of quality teachers in the immediate future. Interventions made by the state in the form of the Technical Education Quality Improvement Programme (TEQIP) was restricted to a few of the established government colleges, and therefore has not been of any help to reverse the quality of faculty in any significant sense. The ability of TEQIP to improve the quality of teachers of even the participating institutions is a debatable proposition. This aspect is discussed in some more detail in section IV.

ii. Aptitude and capability of the students

The common entrance exam was created to allocate seats to students applying for graduate level technical education. It is also expected to be a filter, which will select students with aptitude and capabilities for technical education. Apart from the result of common entrance exams, there is also a requirement of certain minimum marks for the qualifying education for admission to colleges (50% marks in Mathematics and 50% marks in Physics, Chemistry and Mathematics put together, or 3 year Diploma in Engineering with 50 % marks in the Final Diploma examination are also eligible. 5% relaxation for students from socially and economically backward communities). While these mechanisms are expected to ensure that only candidates with an aptitude

5 These are available at the website of the Department of Technical Education, Government of Kerala, http://www.dtekerala.gov.in/index.php?option=com_content&view=article&id=92&Itemid=1 (accessed on February 20, 2012).

for engineering gained admission to technical education institutions, in the liberalised regime, these filters began to show their weakness.

The entrance examination based on objective tests is completely detached from the learning that happens at school. While preparations for the entrance exam help students qualify for admission to engineering colleges, they do not prepare them for higher academic challenges. The boom in private entrance coaching shows how crucial these preparations are for fulfilling students' aspirations. Many educationists in Kerala have pointed out the flaw in selecting students through objective tests. They emphasize the need to include marks from the qualifying education among the criteria for selection. In 2008 an expert committee constituted by government for reform of entrance examinations submitted their report[6]. This report suggested major reforms, which included giving 50 per cent weightage to marks obtained in the qualifying examination while calculating the rank. This will reduce the significance of entrance examination coaching. This new approach was adopted in the entrance examination from 2011 onwards.

Another problem with the entrance examination is that students may obtain a high rank in it even after scoring very low marks (some times even negative) in Mathematics. A random check on the actual marks obtained by candidates in one of the recent entrance examinations revealed this lacuna (State Planning Board, 2006). This means that students with very little mathematical capability are able to get into engineering, which can also affect their subsequent performance.

New self-financing institutions have made the selection process even worse. They allow students who can afford the fees to join engineering courses even if their rank is low. The minimum mark for the

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6. The main recommendations of the expert committee to reform entrance examinations may be found in the government order, http://www.cee-kerala.org/docs/keam2011/reformsreport.pdf (accessed on February 16, 2012).

qualifying exam became the only important criterion to ensure that students with the right ability for technical education is selected. Unfortunately, this requirement is set at such a low base, that many who do not have the required basic knowledge also enroll for technical education. Conflict between the managements of these institutions and the government has led to a situation where different sets of criteria are used for selection by different institutions every year. Some even conduct their own entrance tests. In short, there is no good mechanism to ensure that only meritorious candidates gain admission for technical education.

ii. Other arguments

There is an argument that poor showing by self- financing engineering educational institutions is not necessarily due to their inferior quality but due to the fee differential which attracts better students to government colleges. While there is logic in this argument, there is some evidence, which suggests that it need not be the case. The post- liberalized phase has also seen a spurt in private tuition centers for engineering graduate students. The demand for these centers indicates that colleges are not able to fulfill the learning needs of students.

Hiring teaching staff is a challenge for these newly formed colleges. They mostly employ teachers who have retired from government engineering colleges and fresh graduates. These fresh graduates often do not have any academic experience. A quick look at the list of faculty in engineering colleges under Kerala University shows that only the government and aided colleges and one self-financing college with good results have substantial number of teaching staff with post graduate or higher level education.

IV. Intervention by the state to reverse the trend

For quite some time, there has been recognition especially at the national level that the government has to intervene to improve the quality of technical education in the country. While at one extreme, the

country has the prestigious Indian Institutes of Technology (IITs) and the lesser National Institutes of Technology (NITs), majority of the engineering institutes in the country suffer from poor quality so much to say, that most of the graduates produced by these institutes are not employable by the industry. This has been a constant refrain of the industry (Banerjee and Muley, 2008). Because of the quality factor, there is the paradox of unemployment of engineers coexisting with shortages of it.

As a way of reversing the trend, the government, based on a soft loan from the World Bank has initiated a programme known as Technical Education Quality Improvement Programme (TEQIP). It was started in 2003 with five-year validity but was later extended up to 2009. The project was meant to support the production of high quality technical professionals through reforms in the technical/engineering education system in the country. It had two components. The programme covered selected engineering colleges in eleven states across two cycles. Kerala was one of the first states selected for implementing the programme, and within Kerala five colleges[7] were selected for implementing quality improvements. A cumulative expenditure of Rs 529 million was spent on the five colleges, majority of which (almost 50 per cent) went to one of the oldest colleges under the ownership of the state, namely the College of Engineering, Trivandrum. Since the total number of students in all these five colleges work out only to about 15 per cent of the total number of engineering students in the state, TEQIP coverage was not significant enough to make a dent into the quality of technical education in the state as a whole. Further, the colleges selected were some of the better performing ones. An official evaluation of the TEQIP (Spectrum Planning, 2010) showed that while the programme has been very

7. The five colleges are College of Engineering, Thiruvanthapuram, LBS College of Engineering, Kasargod, Model Engineering College, Kochi, College of Engineering, Chengannur, Sree Chithra Thirunal College of Engineering, Trivandrum. While the former is a government college,the latter four are self-financing colleges of various hues.

successful in improving physical infrastructure, it has not been that successful in terms of faculty development. For instance, the programmes impact in raising the quality of the faculty is very limited (Spectrum Planning, 2010) and also the score that Kerala has received on five of the performance parameters were inferior to the best performing state, namely West Bengal. Impact on academic excellence, although better performing than West Bengal, could have been more if efforts were made to accredit more programmes in the institutions, See Figure 5.

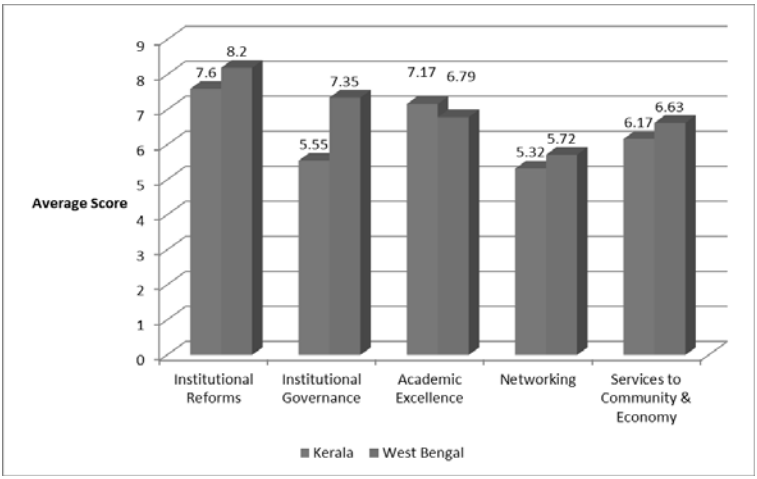

Figure 5: Impact of TEQIP: Kerala vs. West Bengal
Source: Spectrum Planning (2010)

Recent changes in the AICTE norms for appointment of engineering faculty and the initiatives from state government with regard to the qualification for fresh appointments at engineering colleges have the possibility of reducing the scope for fresh graduates of good quality emerging as faculty in engineering colleges. For details of this scheme, see Annexure 2 [8].

8. This is based on a private communication that we had with Professor R V G Menon, a leading engineering educationist from Kerala.

It is interesting to note that the poor quality of engineering education in the state has attracted even the High Court of Kerala. Following the observations made by the Court, the government has appointed an expert committee to draw up guideless for extension of approval, sanctioning of new courses, increase in intake in existing courses etc in self-financing colleges. Based on the recommendations of this committee, the government has on January 31, 2012 passed an order[9] setting out the conditions under which the licenses of existing self-financing colleges may be extended (See Annexure 3 conditions for securing extensions). This extension is now clearly tied to the colleges achieving a certain threshold level of pass rates. The threshold levels fixed are rather low and most of the colleges may not have much difficulty in measuring up to it. However, it will now be instructive to see if the government has the real resolve to implement even this order as if the past is anything to go by.

V. Implications of low OTRs

The low OTRs have a number of adverse implications. First, despite increased investments in engineering education, although in most cases this increased investment has come from the private sector, the actual output in the form of number of engineers graduated has not been commensurate. At a time when the demand for engineers is very high, this low OTR can result in shortages in supply leading to significant increases in the average salary of a graduate engineer. As argued earlier, declining OTRs is also indicative of the declining quality of these engineering graduates. Employability of Indian engineering graduates has been a subject of debate. Although it is generally held that only a small fraction of the graduate engineers are employable, there are no objective indicators for measuring employability. Recently, companies

9 See the website of the Department of Technical Education, Government of Kerala,http://www.dtekerala.gov.in/index.php?option=com_content_&view=_article&id=92&Itemid=1 (accessed on February 20, 2012).

have been using the scores obtained in a test called Aspiring Minds' Computer Adaptive Assessment (AMCAT)[10] to judge employability. Of course, the AMCAT test scores are used, at present, only by IT companies.

According to the AMCAT scores obtained by engineering graduates from Kerala, only 20 per cent of the engineers who took the test are employable in IT services industry. See Figure 6.

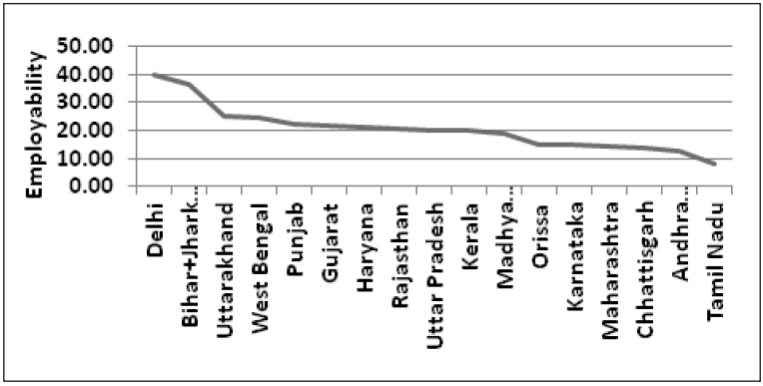

Figure 6: Employability of graduate engineers across 17 states in IT Services Industry, 2010

Source: Aspiring Minds (2011)

Kerala's rank is 10 out of a possible 17. The only consolation, perhaps, is the fact that her position is better than her southern neighbours of Tamil Nadu, Karnataka and Andhra Pradesh. This of course does not make the quality of engineering graduates from Kerala any better.

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10. AMCAT is a multi-dimensional test with the Aptitude (consisting of English, Quantitative Ability and Logical Ability) and AMPI: Aspiring Minds Personality Inventory modules being compulsory and additional skill-specific module which is required for jobs in different sectors. The skill specific modules vary from Computer Programming, Electronics and Communication, Mechanical Engineering, Civil Engineering, Accounts, Marketing, Human Resources, Financial Services, etc. The candidate can choose the skill modules based on his/her education and/or interest.

A second implication of these low OTRs, which has wider societal implications, is the repercussions that these rather high failure rates have on individual families to which these students belong to, and indeed, even to the commercial banking system in the state. Given the high cost of securing a seat in the self-financing colleges, families have secured educational loans, rather easily from the commercial banking system. The educational loans became popular around 2003. Political pressure and popular campaign forced banks to adopt a liberal policy for educational loan approval. This lead to a situation where loans were being made available without checking for the repayment capacity of the borrower. Even collateral was not required for loans of up to Rs 4 Lakhs. According to Vinayan (2011), educational loans have a very high success rate. For instance, according to her, in 2005-06, 97 per cent of applicants for educational loans were successful. This has since tended to come down to about 89 per cent or so by 2008-09. Table 11 summarises the data on educational loans during the 2005-06 through 2010-11 period. The data are not separately available for various disciplines of study (like engineering, medicine, nursing and so on). Vinayan's sample of loan-takers indicates that only 12 per cent are for engineering. So the numbers provided in Table 10 may be taken as a broad indication and must not be attributed to engineering alone. What is striking in the table, is the ever-rising NPAs in the educational loans, which have increased sharply from just 19 crores in 2005-06 to around Rs 279 crores by 2010-11. So the low OTRs are not just a personal waste or tragedy of sorts, but also a societal waste. This certainly calls for some urgent thinking.

Finally, it may be argued that declining OTR can also be a result of rigorous quality control through tough exams. We do not agree with the statement for the following two reasons. First, during the early 1990s, the OTRS, were close to 100 percent. This does not mean that there was less rigorous quality control during the time. So we do not believe in an inverse relationship between OTRs and the degree of quality control.

Table 10: Trends in educational loans sanctioned, disbursed and outstanding (Rs in lakhs)

	Applic-ations	Loans Sanctioned		Loans Sanctioned		Outstanding as on March 31		NPA as at March	
	No	No	Amount	No	Amount	No	Amount	No	Amount
2005-06	34855	33800	62812			111572	134120	2016	1939
2006-07	46949	45224	58437			147633	187112	1887	1697
2007-08	45276	51974	129534.67	76978	130859.77	222748	401054.67	5651	6996.96
2008-09	69300	61501	162448.34	74268	146296.29	229963	372519.34	8926	11385.24
2009-10	52928	45953	108854.76	84473	112519.93	279111	485448.17	10116	14908.05
2010-11	NA	NA	NA	NA	NA	314492	601317.3	10070	27895.94

Source: Vinayan (2011), p. 44; and State Level Bankers' Committee-Kerala (Convenor: Canara Bank)

Second, the additional evidence that we have presented in terms of low employability lends further credence to the fact that low OTRs mean low quality.

VI. Summing Up

The conflict between the management of self-financing colleges and the government has now become an everyday affair. The casualty is the technical education system in Kerala. It is evident that there are no short cuts to achieving the need for technical human resource in the state. Liberalisation of education has not brought in the expected benefits. It is clear that many students who gain admission to engineering colleges do not have the basic capability, which can be built only by improving school education. The case of teaching capability is similar. The private sector cannot be expected to invest in higher education. Unless we transform the higher education sector (at engineering post-graduation level), we will continue to face shortage of quality teachers. Long-term public investment in schools and in higher education is the only solution to the problem. It has its own challenges as the case of TEQIP illustrates.

Controlling the negative consequences of liberalised regime is another challenge. Driven by the dream of lucrative jobs in ICT industry and the easy availability of educational loans, many students opt for technical education without considering their ability and aptitude. Often they are driven by family pressure. Based on the data we have here, increasingly, nearly two thirds of them of them do not obtain a degree even after several attempts to clear the exams. It affects their morale so badly, that some of them even resort to taking their own life rather than accepting failure. This points a finger to a larger social problem in the making. The situation is partly under control now, because of the boom in service sectors like telecommunications and insurance, which absorb some of them on non-technical jobs. However, they do not offer a long-term career path, as graduation is fast becoming the basic qualification for any job. With more colleges joining the fray in 2009-2010, the issue

of failing engineering students is likely to become even more serious. Students from these colleges are yet to reach their final year of education. A similar situation prevails in the case of other technical education streams like Masters in Computer Applications. Neighboring states like Tamil Nadu, where many students from Kerala have enrolled for technical education, are also affected in the same manner.

One good sign though, is that many seats in technical education are vacant these days, which gives the indication that society is becoming more realistic. At the same time, managements of these institutions are forcing governments to change policies so that they get more prey. Demand for reducing the minimum qualification is an example. These institutions only care about intake and fees obtained and not their output. It is unfortunate that the government is driven by pressure from the management and the middle class and not by realities and social development goals as far as technical education in the state is concerned.

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Annexure 1: Trends in intake (in numbers) at undergraduate engineering degree courses across states and union territories: 1990-91 through 2007-08

States/UTs	1990-91	2007-08	Average annual growth rate (%)
Andhra Pradesh	8070	82970	54.60
Tamil Nadu	12855	80417	30.92
Maharashtra	20425	48250	8.01
Karnataka	19452	46375	8.14
Uttar Pradesh		28953	
Kerala	4512	24413	25.95
Madhya Pradesh	2265	20210	46.60
West Bengal		15477	
Rajasthan	1629	15045	48.45
Punjab	1508	14880	52.16
Orissa	1325	13014	51.89
Gujarat	2780	12965	21.55
Haryana	1085	12785	63.43
Delhi	1290	4330	13.86
Chatisgarh		4020	
Jharkhand		3385	
Pondicherry	300	2370	40.59
Bihar	2375	1905	-1.16
Jammu & Kashmir	480	1545	13.05
Uttaranchal		1440	
Himachal Pradesh	210	1260	29.41
Chandigarh	465	800	4.24
Assam	660	750	0.80
Goa	154	740	22.38
Sikkim		525	
Meghalaya		240	
Arunachal Pradesh	210	210	0.00
Tripura	120	180	2.94
Mizoram		120	
Manipur		115	
Total	**82170**	**439689**	**25.59**

Source: Ministry of Human Resource Development (2011)

Annexure 2: Recent changes in AICTE norms for appointments as faculty in engineering colleges and its perceived implications on quality of faculty.

Until the most recent AICTE salary reform, the minimum qualification for an engineering college Lecturer was a first class B.Tech. One needed an M.Tech for promotion as Assistant Professor. So, after a couple of years of service as Lecturer, they would proceed on leave for higher studies. There were also government programmes for deputing them for higher studies. Because they were already employed they would be highly motivated in specialising in some particular area, which was relevant to their work. It was with the last reform that the post of Lecturer was abolished and recruitment category was fixed as AP. A new category of Associate Professor was created in lieu of the earlier AP post. There can be difference of opinion about the impact of this change on the quality of the faculty. When the recruitment was open to fresh B.Tech graduates with good academic record, many young bright graduates used to opt for teaching. However, when M.Tech is made the minimum qualification, this route is closed. An intending teacher has to first get an M.Tech and then only can apply for a teacher's post. This could discourage many eager youngsters from opting for teaching career, because of the uncertainty.

Source: Private communication from R.V.G Menon dated March 19, 2012.

Annexure 3 : Conditions set out for securing extension of the approval of existing self-financing engineering colleges in Kerala

- Extension of approval shall be granted to all the existing self-financing institutions in the state for the year 2012-13. But for the year 2013-14, extension of approval will be granted only to the institutions with minimum running average pass percentage in the first appearance in all subjects (full pass) up to IV, VI and VIII semesters of 25%, 30%, and 35% respectively and for the year 2014-15 at 30%, 35%, and 40% respectively.

- There shall be an initial period for all institutions to stabilise its academic operations before new courses are approved. From the year 2012-2013, for commencing new B.Tech courses or for increase in intake of students in existing courses, the following conditions shall apply:

  i. Only those institutions, which have run B.Tech courses for 4 Semesters (i.e. whose first batch of students have reached at least Vth semester of the course and whose results up to IVth semester have been published), are eligible to apply for new B.Tech courses in the intake in the existing B.Tech course.

  ii. Sanction will only be given to those institutions with minimum running average pass percentage in the first appearance in all subjects (full pass) up to IV, VI, and VIII semesters having a minimum of 35%, 40% and 45% respectively.

- Only those institutions which have run B.Tech courses for 3 years (i.e., whose first batch of students have reached at least VIIth semester of the course and whose results up to VIth semester have been published) will be eligible for starting M.Tech courses. From the year 2012-2013, for new M.Tech courses in existing self-financing institutions which offer B.Tech courses, only those institutions which have at least 7 faculty members with M.Tech Degrees in that branch of Engineering will be eligible. The minimum running average pass percentage in the first appearance in all subjects (full pass) up to VIth and VIIIth semesters shall be 40% and 50% respectively in the existing B.Tech courses.

Source: Department of Technical Education, Government of Kerala, http://www.dtekerala.gov.in/index.php? option=com_content &view=article&id=92&Itemid=1 (accessed on February 20, 2012).

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