The performance of research-intensive higher educational institutions in India

Gangan Prathap

The institutions belonging to the higher education sector taken together are the biggest contributor to India's academic research output. In this article we use the datasets from the 2013 release of SCImago Institutions Rankings World Reports to evaluate the longitudinal performance of the quality and quantity of research output of select institutions belonging to this sector for the period 2003–2011. All institutions in this elite category have a reasonable to high growth rate in output. However, from the quality angle, we see that the high performers which are mainly the institutions of national importance are now at a relatively low growth level. We also identify a few institutions which are showing promisingly high rates of improvement in quality of research.

Keywords: Higher education, institutions, longitudinal performance, research output.

UNIVERSITY rankings are now taken seriously. The first global university rankings became available in 2003 when Shanghai Jiao Tong University published the results in what is now known as the Academic Ranking of World Universities (ARWU)[1]. While three Indian institutions appeared in the world rankings in 2003 (Indian Institute of Science (IISc), Bangalore in the 251–300 bracket and the Indian Institutes of Technology (IITs) at Delhi and Kharagpur in the 451–500 bracket), only one remained in 2013 (IISc dropping down to the 301–400 bracket). The Shanghai ARWU rankings are based mainly on research indicators, as are many other similar rankings, e.g. the Leiden rankings, the Taiwan Higher Education Accreditation Evaluation Council university Ranking (HEEACT), and the EU Assessment of University-Based Research (AUBR)[2]. The European University Association report[2] confirms that most international rankings focus predominantly on indicators related to the research function of universities. It is therefore meaningful in the present exercise to focus on the research contributions of higher educational institutions (HEIs) in India. These research-intensive institutions belonging to the higher education sector are the biggest contributor to India's academic research output. Indeed in 2013, 16 out of the top 20 research organizations in India ranked by output (SIR global India 2013 – rank: output 2007–2011) belonged to this sector. We will look critically at the evolution of research performance of the institutions from this sector using composite indicators derived from the indicators in the SCImago Institutions Rankings (SIR) World Reports[3].

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SIR World Reports

The SIR World Reports (http://www.scimagoir.com/) evaluate the research performance of leading research institutions in the world, using bibliometric data from *Scopus* (www.scopus.com), an Elsevier product. The bibliometric analysis is based on indicators addressing issues like the scientific impact, thematic specialization, output size and international collaboration networks of the institutions. Typically a report for a year covers the output over a rolling window of five years previous to that year (e.g. the report for 2009 covers the period 2003–07). The institutions have been chosen on the basis of having published at least 100 scientific documents of any type, that is, articles, reviews, short reviews, letters, conference papers, etc. during the last year of the respective five-year window as collected by *Scopus*. This selection of institution accounts for nearly 80% of all research (according to the *Scopus* database). In the report for 2013, 138 institutions belonging to the higher education sector from India appear in this list. Each institution is then given default rankings within the SIR for world rank (WR), regional rank (RR) and country rank (CR), based only on the quantity of scientific output. This ranking scheme does not factor in the quality angle at all.

An attractive feature of the SIR exercise, and of particular interest to us in this analysis, is that unlike other similar ranking exercises, it is based on bibliometric data that can be directly identified with quantity and quality attributes[2].

Methodology

We shall use the datasets from the latest (2013) release of SIR World Reports to evaluate the performance of

institutions belonging to this sector. This release has regenerated the reports from 2009 to 2013 into a single format so that each one of them reflects the current state of the database at all times with retrospective data loads that maintain consistency between the reports and the *Scopus* database. This enables one to do longitudinal studies as well that can trace the evolution of progress over the recent past.

The report for 2013, for example, covers the output from 2007 to 2011. Thus by doing a longitudinal examination of the latest five reports, we are in effect covering the bibliometric indicators of the period from 2003 to 2011. The bibliometric indicators in the SIR are proxies chosen to cover the main quantity (output) and quality (scientific impact) dimensions of research performance of each institution as well as additional proxies that measure attributes like thematic specialization and the international collaboration networks of the institutions. The count of scientific documents takes into account articles, reviews, short reviews, letters, conference papers, etc. as collected by one of the leading aggregators of bibliometric data, namely *Scopus*.

In the latest reports, eight bibliometric indicators are shown. Of these, we shall for the purpose of our present exercise use only four: one which can be identified with the quantity attribute and another three with quality attributes. Thus, the O (or output) indicator is a measure of the quantity or size of the publication output of an institution and is the total number of documents published in scholarly journals indexed in *Scopus*. The three which are proxies in various ways of the quality of academic research output are:

1. The NI (or normalized impact) compares the average scientific impact of the institution with the world average (taken as 1). Thus a score of 0.8 implies a 20% below average citation performance, while a score of 1.3 means the institution is cited 30% above average.
2. The Q1 (or high quality publications), which is the ratio of publications that the institution publishes in what the SCImago team takes as the most influential scholarly journals of the world; those ranked in the first quartile (25%) in their categories as ordered by SCImago Journal Rank. Since this is reported as a percentage, the ratio (Q1/25) is again another normalized proxy for quality of publication, with a value of 1 taken as the world average.
3. The ER (or excellence rate), which indicates the percentage of an institution's scientific output that is included into the set formed by 10% of the most cited papers in the respective scientific fields, and serves as a measure of the high quality output of research institutions. Again, the ratio ER/10, allows one to normalize this proxy so that the world average becomes 1.

An important point to be made here is that these three indicators intrinsically cover what is called the field-normalization aspect[2]; i.e. they account for the fact that the different publication and citation practices across disciplines lead to significantly different citation rates and that this can be normalized by adopting NI, Q1 and ER as bibliometric indicators. Default ranking using output as a single criterion is easy as it is a uni-dimensional indicator. However, as we have three quality indicators, ranking by quality needs these three to be combined into a single composite quality indicator. It is possible to use a Euclidean measure to combine these three quality proxies into a single one. We propose for this purpose, the q^2 proxy, where q^2 is defined as $((\mathrm{NI})^2 + (\mathrm{Q1}/25)^2 + (\mathrm{ER}/10)^2)/3$. This has the simplicity that it is a composite quality indicator with a value of 1 describing the world norm constituted from three indicators, namely NI, Q1/25 and ER/10, each of which defines a world norm with a value of 1. Thus we have in this analysis, simplified the SIR reports data to a quantity term ($Q = O$) and quality term (q^2). The single composite term, $X = q^2Q$, is that term that serves as the best proxy for total performance in the research context. Thus the best way in which progress can be displayed on a two-dimensional map is to plot the trajectories on a $q^2 - Q$ diagram[4].

Results and discussion

We have prepared a league table (Table 1) showing the 138 HEIs that appear from India in SIR 2013. Of these 138, the largest share goes to Tamil Nadu (28), followed by Uttar Pradesh and Karnataka with 11 each and Maharashtra with 10. Among the bigger states, Bihar is conspicuously absent; no HEI from that state appears in this list of elite institutions. The original default ranking of SIR 2013 is shown along with rankings based on the quality indicator and the exergy indicator. On the exergy criterion, IISc and the five old IITs rank right at the top. On the quality criterion alone (i.e. the composite q^2 indicator) we find the Jawaharlal Nehru Centre for Advanced Scientific Research, the Tata Institute of Fundamental Research and the National Institute of Pharmaceutical Education and Research taking the top three positions.

Table 1 gives only a static picture as of 2013. We would like to see what happens longitudinally over the period 2009–2013. For this purpose, we group the institutions into easily recognized categories. In one category, we group together the various institutions on national importance in the country like IISc, IITs, the Indian Institute of Information Technology (IIIT), etc. Table 2 shows the time evolution of the exergy indicator from 2009 to 2013 of these prestigious Indian institutes. IISc, which is the premier research-intensive HEI in the country heads the table. Of the sixteen IITs in existence now, eight make it to this list. Only one of the IIITs

Table 1. Ranking of higher education institutions (HEIs) appearing in SIR 2013 according to various indicators

Higher education institutions	Values			Rankings		
	Output	q^2	X	Output	q^2	X
Indian Institute of Science	9,111	2.44	22221.51	1	4	1
Indian Institute of Technology, Kharagpur	7,665	1.93	14816.90	2	9	2
Indian Institute of Technology, Bombay	5,822	2.12	12369.41	7	7	3
Indian Institute of Technology, Delhi	6,629	1.78	11799.68	3	14	4
Indian Institute of Technology, Madras	6,252	1.85	11573.71	5	11	5
Indian Institute of Technology, Kanpur	5,075	2.10	10658.27	10	8	6
Tata Institute of Fundamental Research	3,490	3.01	10515.64	14	2	7
University of Delhi	6,488	1.32	8534.83	4	30	8
Banaras Hindu University	5,336	1.38	7374.12	8	26	9
Indian Institute of Technology, Roorkee	4,277	1.64	7031.46	12	17	10
Panjab University	2,895	2.33	6741.71	18	5	11
Jawaharlal Nehru Centre for Advanced Scientific Research	1,325	4.41	5841.20	41	1	12
Jadavpur University	5,201	1.10	5696.60	9	36	13
All India Institute of Medical Sciences	5,992	0.91	5445.68	6	53	14
Indian Institute of Technology, Guwahati	2,626	1.77	4639.72	20	15	15
University of Hyderabad	2,223	1.76	3911.71	21	16	16
University of Calcutta	2,869	1.01	2907.39	19	42	17
Anna University	4,832	0.58	2789.36	11	86	18
Aligarh Muslim University	3,124	0.84	2630.44	17	56	19
University of Pune	1,870	1.39	2604.81	25	24	20
Shivaji University	1,121	2.30	2578.09	49	6	21
Postgraduate Institute of Medical Education and Research	3,700	0.70	2575.24	13	73	22
Jawaharlal Nehru University	1,766	1.39	2453.98	26	25	23
National Institute of Pharmaceutical Education and Research	796	2.80	2226.43	77	3	24
Annamalai University	3,152	0.68	2143.37	16	76	25
Indian Statistical Institute	2,142	0.94	2021.98	22	48	26
Guru Nanak Dev University	1,349	1.32	1786.32	39	29	27
Birla Institute of Technology and Science	1,116	1.59	1777.11	50	19	28
Christian Medical College, Vellore	1,640	1.04	1699.13	30	38	29
National Institute of Technology, Tiruchirappalli	1,624	1.04	1690.45	32	37	30
Visva-Bharati University	909	1.79	1629.95	66	13	31
University of Madras	2,036	0.77	1566.42	23	61	32
Jamia Hamdard University	1,213	1.23	1494.01	46	33	33
University of Mumbai	1,160	1.23	1431.53	48	32	34
Institute of Chemical Technology, Mumbai	776	1.83	1416.39	82	12	35
Bengal Engineering and Science University, Shibpur	1,230	1.13	1384.42	45	35	36
Sanjay Gandhi Postgraduate Institute of Medical Sciences	1,658	0.81	1341.12	29	57	37
National Institute of Technology, Rourkela	1,333	0.97	1287.43	40	46	38
Sree Chitra Tirunal Institute for Medical Sciences and Technology	908	1.41	1277.93	67	23	39
Dr Harisingh Gour University	846	1.45	1230.43	70	21	40
Bharathidasan University	1,191	1.03	1223.54	47	41	41
Jamia Millia Islamia Central University	1,320	0.90	1194.38	42	55	42
Allahabad University	1,425	0.80	1146.78	36	58	43
Cochin University of Science and Technology	1,422	0.78	1110.41	37	60	44
Manipal University	3,356	0.33	1100.44	15	116	45
National Institute of Mental Health and Neuro Sciences	1,079	1.00	1077.76	54	43	46
Gandhigram Rural Institute	572	1.87	1071.98	100	10	47
University of Rajasthan	1,631	0.63	1019.90	31	80	48
VIT University	1,721	0.58	990.04	27	87	49
Sri Venkateswara University	1,386	0.70	965.76	38	72	50
Bharathiar University	1,057	0.91	960.72	56	52	51
Tezpur University	668	1.42	950.13	88	22	52
The Maharaja Sayajirao University of Baroda	1,280	0.72	922.57	44	71	53
National Institute of Technology, Durgapur	796	1.03	821.15	78	40	54
Punjabi University	1,082	0.76	820.87	53	65	55
Bangalore University	1,076	0.76	819.90	55	64	56
Alagappa University	606	1.35	815.60	96	28	57
University of Kalyani	1,011	0.76	763.63	59	66	58
Madurai Kamaraj University	938	0.80	753.33	63	59	59
Pondicherry University	787	0.94	742.00	80	49	60

(*Contd*)

Table 1. (*Contd*)

Higher education institutions	Values			Rankings		
	Output	q^2	X	Output	q^2	X
University of Jammu	539	1.37	736.45	107	27	61
Karnatak University	927	0.75	698.90	64	67	62
University of Lucknow	978	0.67	654.33	61	78	63
University of Burdwan	869	0.75	654.28	69	68	64
National Institute of Technology, Hamirpur	440	1.47	646.89	122	20	65
Guru Jambheshwar University of Science and Technology	600	1.03	619.01	97	39	66
Motilal Nehru National Institute of Technology	806	0.76	614.96	74	63	67
Birla Institute of Technology	975	0.61	590.67	62	82	68
University of Kerala	794	0.74	589.85	79	69	69
Chhatrapati Shahuji Maharaj Medical University	1,030	0.57	585.54	58	90	70
Jiwaji University	455	1.23	557.83	120	34	71
Amrita University	575	0.95	546.52	99	47	72
Thapar University	912	0.59	537.94	65	83	73
National Institute of Technology Karnataka	1,087	0.49	534.30	52	97	74
Jai Narain Vyas University	556	0.93	515.96	102	50	75
Osmania University	1,456	0.35	508.08	34	111	76
University of Mysore	1,940	0.26	499.21	24	126	77
Kalasalingam University	392	1.26	493.93	129	31	78
Mahatma Gandhi University	487	0.97	471.78	116	45	79
Devi Ahilya University	673	0.70	467.74	86	74	80
Loyola College	506	0.91	462.54	111	51	81
Indian Veterinary Research Institute	1,493	0.31	462.36	33	119	82
Kuvempu University	619	0.73	453.69	93	70	83
Delhi Technological University	446	0.98	436.52	121	44	84
Kurukshetra University	1,038	0.41	430.34	57	103	85
Bharati Vidyapeeth Deemed University	471	0.91	426.38	118	54	86
Gulbarga University	637	0.62	395.52	91	81	87
Thiagarajar College of Engineering	736	0.53	391.49	83	95	88
Sathyabama University	583	0.66	387.22	98	79	89
Shanmugha Arts, Science, Technology and Research Academy	651	0.59	383.09	90	84	90
Himachal Pradesh University	546	0.69	377.93	104	75	91
Dr Babasaheb Ambedkar Marathwada University	680	0.55	374.46	85	93	92
Sri Siva Subramania Nadar College of Engineering	530	0.68	357.79	109	77	93
International Institute of Information Technology, Hyderabad	823	0.43	351.86	73	101	94
Indian School of Mines	626	0.55	345.50	92	92	95
Mangalore University	1,431	0.24	345.29	35	127	96
Jawaharlal Nehru Technological University, Hyderabad	1,282	0.27	342.81	43	124	97
Guru Gobind Singh Indraprastha University	436	0.77	335.16	124	62	98
Andhra University	1,716	0.19	333.94	28	131	99
Sardar Patel University	670	0.49	328.46	87	98	100
North-Eastern Hill University	564	0.57	321.80	101	89	101
Rashtrasant Tukadoji Maharaj Nagpur University	714	0.45	321.66	84	100	102
PSG College of Technology	981	0.31	306.99	60	117	103
Punjab Agricultural University	1,114	0.27	301.32	51	123	104
Vidyasagar University	496	0.57	284.11	114	88	105
Sri Ramaswamy Memorial University	798	0.33	263.14	76	115	106
Sri Krishnadevaraya University	533	0.49	259.37	108	99	107
Indian Institute of Technology, Hyderabad	156	1.63	254.72	138	18	108
University College of Medical Sciences	806	0.31	247.67	75	120	109
Saurashtra University	438	0.54	238.52	123	94	110
Mohan Lal Sukhadia University	548	0.42	228.18	103	102	111
North Maharashtra University	384	0.56	215.20	131	91	112
Gauhati University	613	0.34	208.79	95	113	113
Maharshi Dayanand University	498	0.41	203.23	112	105	114
Sri Ramachandra University	497	0.41	203.23	113	104	115
Amity University	367	0.50	184.63	132	96	116
Dr B.R. Ambedkar National Institute of Technology	462	0.40	182.71	119	107	117
Periyar University	474	0.39	182.50	117	109	118
National Institute of Technology Kurukshetra	540	0.33	179.38	106	114	119
Tamil Nadu Agricultural University	842	0.21	178.46	71	130	120

(*Contd*)

Table 1. (*Contd*)

Higher education institutions	Values			Rankings		
	Output	q^2	X	Output	q^2	X
National Institute of Technology, Warangal	616	0.28	173.11	94	122	121
University of Kashmir	492	0.34	167.96	115	112	122
Jaypee University of Information Technology	432	0.38	164.51	126	110	123
Assam University	276	0.58	161.14	136	85	124
Acharya Nagarjuna University	542	0.29	157.41	105	121	125
Deen Dayal Upadhyay Gorakhpur University	389	0.39	151.75	130	108	126
Govind Ballabh Pant University of Agriculture and Technology	871	0.17	144.32	68	134	127
Kakatiya University	787	0.18	142.81	81	132	128
Hemwati Nandan Bahuguna Garhwal University	529	0.26	137.70	110	125	129
Malaviya National Institute of Technology	424	0.31	132.56	127	118	130
Banasthali University	289	0.40	115.01	135	106	131
Karunya University	435	0.23	98.29	125	129	132
Chaudhary Charan Singh Haryana Agricultural University	839	0.10	83.79	72	137	133
Dibrugarh University	296	0.23	67.91	134	128	134
Government College of Technology	363	0.17	63.28	133	133	135
GITAM University	399	0.15	58.37	128	135	136
Tamil Nadu Veterinary and Animal Sciences University	655	0.06	39.58	89	138	137
Karpagam University	230	0.13	31.01	137	136	138

Table 2. Time evolution of the exergy indicator of the prestigious Indian institutes from 2009 to 2013

Indian institutes	X				
	2009	2010	2011	2012	2013
Indian Institute of Science (IISc)	14,789	16,383	17,946	18,482	22,222
Indian Institute of Technology, Kharagpur (IITKgp)	8,919	10,585	12,051	13,243	14,817
Indian Institute of Technology, Bombay (IITB)	7,693	8,764	9,777	10,624	12,369
Indian Institute of Technology, Delhi (IITD)	8,339	9,202	10,084	9,967	11,800
Indian Institute of Technology, Madras (IITM)	6,902	8,235	9,619	9,873	11,574
Indian Institute of Technology, Kanpur (IITKnp)	8,926	9,192	9,150	8,954	10,658
Indian Institute of Technology, Roorkee (IITR)	3,724	4,828	5,522	5,876	7,031
Indian Institute of Technology, Guwahati (IITG)	1,756	2,376	3,143	3,586	4,640
International Institute of Information Technology, Hyderabad (IIITH)	121	187	245	383	352
Indian Institute of Technology, Hyderabad (IITH)	0	0	0	0	255

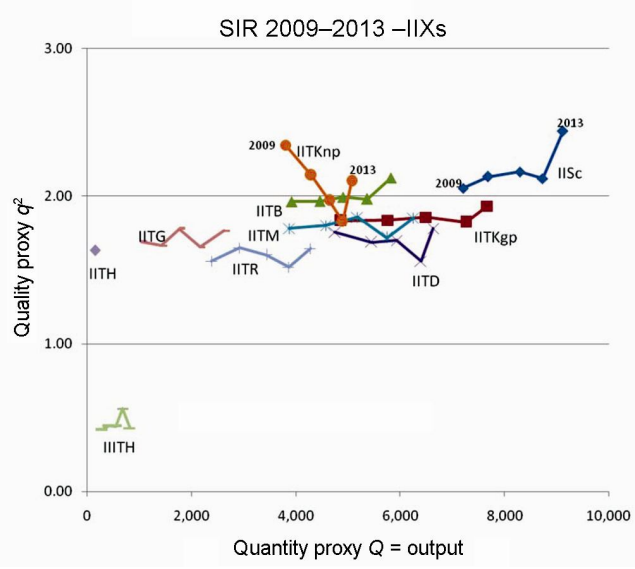

Figure 1. Performance trajectory of the prestigious Indian Institutes from 2009 to 2013 on a quality–quantity two-dimensional map.

appears in this elite list. Figure 1 shows the trajectories of the same institutions from 2009 to 2013 on a quality–quantity two-dimensional map. In all cases, the output and the quality indicators have shown a steady progression. Only in the case of IIT Kanpur has there been some decline in the quality indicator from 2009 to 2012 and this trend has reversed in 2013. Among the newest IITs, only the one in Hyderabad has begun to appear in the SIR rankings. The IIIT, Hyderabad is seen to have a poor quality value when compared to the IITs. The other IIITs and other very new IITs are yet to make their mark.

Table 3 shows the time evolution of the exergy indicator from 2009 to 2013 of the 13 Central Universities (of a total of 42 such institutions in India) that come into the SIR 2013 list. Figure 2 shows the performance trajectories of the Central Universities from 2009 to 2013 on a quality–quantity two-dimensional map. All the institutions here show a steady rise in output and quality; the most remarkable progress in quality terms is that of Viswa-Bharati University, accompanying a modest increase in output.

Table 3. Time evolution of the exergy indicator of the Central Universities from 2009 to 2013

	X				
Central universities	2009	2010	2011	2012	2013
University of Delhi	3320.65	4148.23	4750.27	5618.05	8534.83
Banaras Hindu University	2349.93	2949.57	3919.46	5085.88	7374.12
University of Hyderabad	2331.60	2453.52	2718.62	3069.76	3911.71
Aligarh Muslim University	988.04	1103.71	1480.61	1761.43	2630.44
Visva-Bharati University	290.54	372.01	486.19	844.22	1629.95
Doctor Harisingh Gour University	682.92	891.39	947.05	1063.19	1230.43
Jamia Millia Islamia Central University	704.58	886.05	880.29	993.84	1194.38
Allahabad University	332.24	445.62	614.44	777.58	1146.78
Tezpur University	0.00	355.86	445.99	547.48	950.13
Pondicherry University	0.00	352.52	411.79	487.16	742.00
North-Eastern Hill University	183.66	198.92	211.39	206.60	321.80
Assam University	0.00	0.00	0.00	0.00	161.14
Hemwati Nandan Bahuguna Garhwal University	0.00	0.00	0.00	66.25	137.70

Table 4. Time evolution of the exergy indicator of the National Institutes of Technology from 2009 to 2013

	X				
Institution	2009	2010	2011	2012	2013
National Institute of Technology Tiruchirappalli	527	767	955	1,243	1,690
National Institute of Technology Rourkela	263	430	771	1,135	1,287
National Institute of Technology Durgapur	0	0	212	470	821
National Institute of Technology Hamirpur	0	0	0	482	647
Motilal Nehru National Institute of Technology	0	242	380	512	615
National Institute of Technology Karnataka	0	263	310	382	534
Dr B.R. Ambedkar National Institute of Technology	0	0	0	141	183
National Institute of Technology, Kurukshetra	0	0	0	177	179
National Institute of Technology, Warangal	0	90	111	112	173
Malaviya National Institute of Technology	0	0	0	113	133

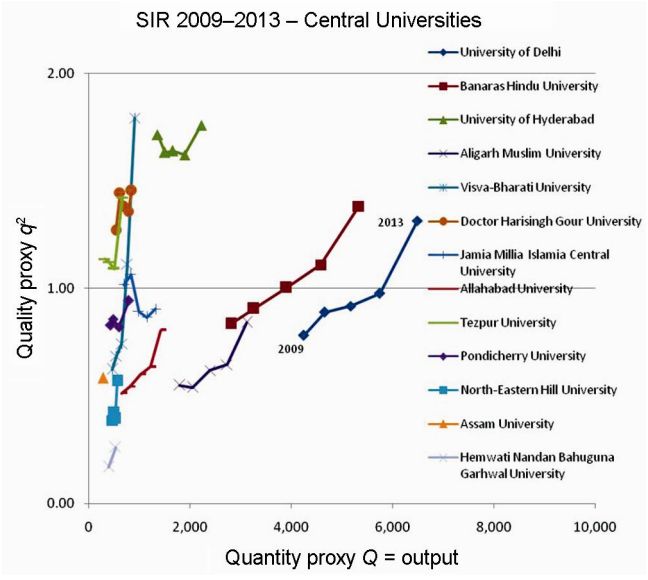

Figure 2. Performance trajectory of the Central Universities from 2009 to 2013 on a quality–quantity two-dimensional map.

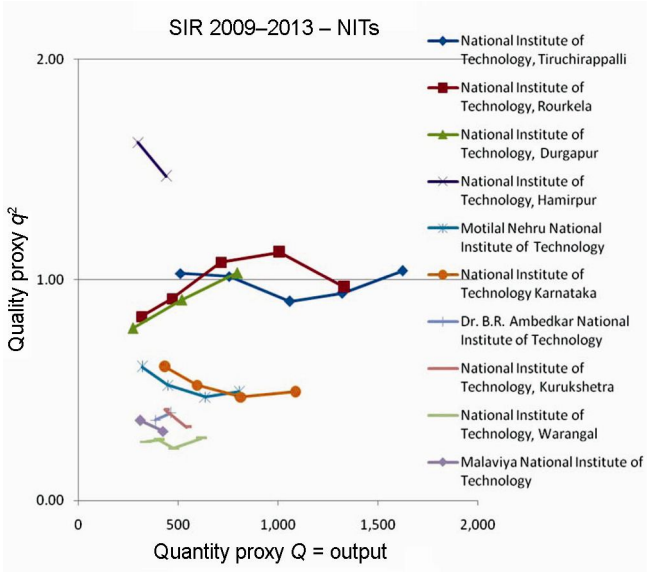

Figure 3. Performance trajectory of the National Institutes of Technology from 2009 to 2013 on a quality–quantity two-dimensional map.

Table 4 shows the time evolution of the exergy indicator from 2009 to 2013 of the 10 National Institutes of Technology (of a total of 30 such institutions in India today). Figure 3 shows the performance trajectories of these institutions from 2009 to 2013 on a quality–quantity two-dimensional map. A mixed picture is seen. Except

Table 5. Time evolution of the exergy indicator of the leading medical institutions in India from 2009 to 2013

	X				
Medical institutions	2009	2010	2011	2012	2013
All India Institute of Medical Sciences	2,906	3,330	3,721	4,062	5,446
Postgraduate Institute of Medical Education and Research	1,511	1,624	1,773	1,930	2,575
Christian Medical College, Vellore	884	1,047	1,139	1,225	1,699
Sanjay Gandhi Postgraduate Institute of Medical Sciences	950	1,039	1,087	1,073	1,341
Sree Chitra Tirunal Institute for Medical Sciences and Technology	420	474	616	616	1,278
National Institute of Mental Health and Neuro Sciences	776	859	875	905	1,078
Chhatrapati Shahuji Maharaj Medical University	304	371	447	453	586
University College of Medical Sciences	0	110	136	174	248
Sri Ramachandra University	0	0	0	139	203

Table 6. Time evolution of the exergy indicator of the leading Indian institutions in the private sector from 2009 to 2013

	X				
Private institutions	2009	2010	2011	2012	2013
Birla Institute of Technology and Science	1,184	1,204	1,351	1,402	1,777
Manipal University	396	488	609	725	1,100
Gandhigram Rural Institute	0	0	548	697	1,072
VIT University	113	239	435	638	990
Amrita University	0	0	299	299	547
Thapar University	0	218	270	315	538
Kalasalingam University	0	0	0	0	494
Loyola College	0	267	0	0	463
Bharati Vidyapeeth Deemed University	0	0	0	323	426
Thiagarajar College of Engineering	0	134	242	260	391
Sathyabama University	0	0	0	495	387
Shanmugha Arts, Science, Technology and Research Academy	0	0	205	237	383
Sri Siva Subramania Nadar College of Engineering	0	0	125	217	358
PSG College of Technology	172	198	233	259	307
Amity University	0	0	0	151	185
Jaypee University of Information Technology	0	0	123	0	165
Banasthali University	0	0	0	0	115
Karunya University	0	0	0	0	98
GITAM University	0	0	0	0	58
Karpagam University	0	0	0	0	31

for NIT, Durgapur, most of the other NITs have difficulty in increasing the quality of their output even as the quantum of output increases.

Table 5 shows the time evolution of the exergy indicator from 2009 to 2013 of nine leading medical institutions in the higher education sector engaged in research in India. Figure 4 shows the trajectories of these institutions from 2009 to 2013 on a quality–quantity two-dimensional map. All institutions register an increase in output. The Sree Chitra Tirunal Institute for Medical Sciences and Technology and the Christian Medical College, Vellore have shown remarkable increase in the quality parameter. The National Institute of Mental Health and Neuro Sciences, and Chhatrapati Shahuji Maharaj Medical University show decline in their respective quality proxies. The University College of Medical Sciences, Delhi and Sri Ramachandra University, Chennai have made a modest but promising entry into this league table.

The higher education space in India was for a long time entirely in the government or public sector. However, steadily, the role of the private sector has increased and in many states, especially in the professional education sector, private and for-profit agents control as much as 80–90% of the institutions. Table 6 is a representative list of many of the institutions from this category. We see that the leading institution in this category, the Birla Institute of Technology and Science is nowhere near the top institutions in the country in terms of output (an indirect indication of the size of the institution), but has a quality level that is comparable to some of the institutions in the top bracket. In direct contrast, Manipal University has a large output but is severely compromised on quality. Figure 5 shows the performance trajectories of some of the leading institutions in the private sector engaged in research in India from 2009 to 2013 on a quality–quantity two-dimensional map. An encouraging insight from this

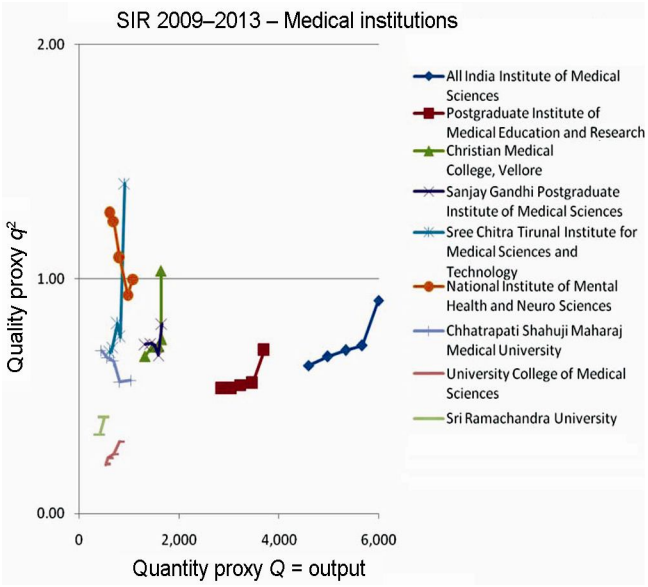

Figure 4. Performance trajectory of the leading medical institutions engaged in research in India from 2009 to 2013 on a quality–quantity two-dimensional map.

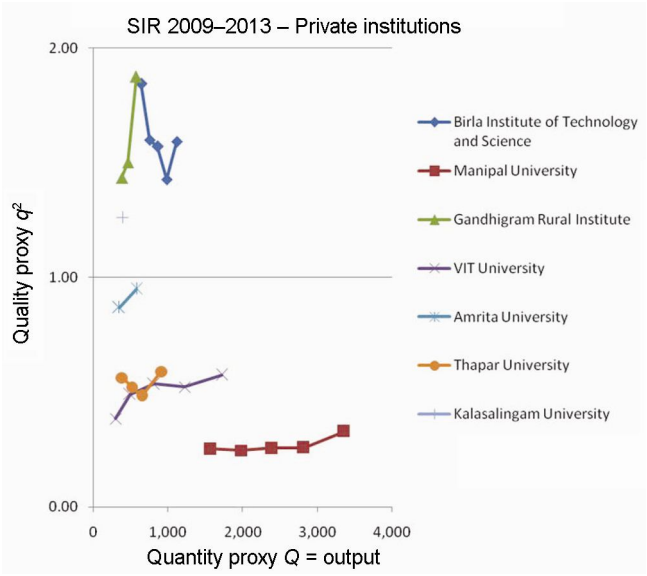

Figure 5. Performance trajectory of some of the leading institutions in the private sector engaged in research in India from 2009 to 2013 on a quality–quantity two-dimensional map.

figure is the promising growth in research shown by three privately managed institutions, the Gandhigram Rural Institute, Amrita University and VIT University.

Conclusions

We have used datasets from the 2013 release of SIR World Reports to evaluate the longitudinal performance of the quality and quantity of research output of institutions belonging to the higher education sector for the period 2003–2011. These institutions taken together are the biggest contributor to India's academic research output. In this article we see that all institutions have a reasonable to high growth rate in terms of quantity of output. However, from the quality angle, we see that the high performers, which are mainly the institutions of national importance are now at a relatively low growth level. We also identify a few institutions which are showing promisingly high rates of improvement in the quality of research.

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