Evaluation of Asian university rankings: position and perspective of leading Indian higher education institutions

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Although the subject of ranking higher education institutions is frequently elaborated in many research papers, consensus about a leading ranking methodology has not been reached yet. Consequently, different methodologies are based on rather conflicting indicators and therefore often provide highly diverse rankings of the world's best universities. For instance, SCImago Institutions Rankings (SIR) methodology is exclusively based on indicators of scientific output, while Times Higher Education World University Rankings (THE) and Quacquarelli Symonds World University Rankings (QS) take into account the teaching dimension of the university performance to a large degree. To explore the impact of different methodologies further, we first obtained data on Asian best-ranked universities according to SIR, THE and QS methodologies. The aim of this article is to explore possibilities to enhance ranking methodologies using I-distance method. The result was manifold: first, by employing our I-distance approach we were able to point out potential weaknesses of subjectively chosen weighting factors of THE and QS ranking methodologies. Secondly, we were able to provide detailed information on how each QS and THE indicator contributes to the final rank and emphasize the crucial indicators in the process of ranking. Thirdly, SIR does not provide the total score and its appropriate rank; and using our approach not only did we provide the total score but also determined the relative significance of each compounding SIR indicator. One of the contributions lies in the use of the I-distance method, which can easily integrate variables with different measurement units into one composite indicator. Moreover, our approach could be a foundation for impartial framework of universities' assessment, independent of subjectively formed weighting factors. Finally, a special overview of university performances of leading Indian universities is provided.

Keywords: Higher education, I-distance method, university rankings, methodologies and indicators.

WITH many different approaches in the field of university rankings, the question often raised is whether rankings and ratings are more science or voodoo[1]. One can argue that 'University rankings are very appealing in that they provide a single number that allows, at a glance, to situate a given university in the worldwide context. However, this very simplicity of use can be highly misleading in that most rankings are based on a simple formula that aggregate subjectively chosen indicators'[2]. Rankings have heightened competition between institutions and by doing so, 'rankings are creating a social norm against which all institutions are measured'[3]. While higher education has always been competitive, 'rankings make perceptions of prestige and quality explicit'[3], and they 'have raised the competitive bar and heaped pressure on institutions and systems – becoming the driver for significant restructuring and the means by which success and failure are gauged'[3].

Taking everything into account, one cannot argue the importance of this research topic, since official rankings attract many different stakeholders, especially students and are often used as an indicator of a university's reputation and performance[3–6]. It is often said that the subject of university rankings 'reflects a problem of increasing proportions faced by Universities in East Asia'[7]. In the race to improve their rankings and attract better media attention and brilliant students, Asian universities need to 'ride a tiger … of the world university rankings'[7]. Given this, our article will emphasize several important issues, i.e. recognizing potential weaknesses of existing methodologies and finding out possible remedies. We give an overview of the most prominent Asian university ranking

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methodologies. To this end, we obtain data of best Asian universities by SIR, THE and QS methodologies. The statistical I-distance method has been used to analyse the obtained data. The goal is twofold: (i) By employing this approach we were able to point out potential weaknesses of subjectively chosen weighting factors of THE and QS ranking methodologies. This is particularly interesting since the nominal weights of THE and QS methodologies have been frequently criticized in various publications[8,9]. Our approach provides detailed information on how each of the QS and THE indicators contributes to the final rank and stresses on crucial indicators in the process of ranking. (ii) SIR does not provide the total score and its appropriate rank; thus, using our approach we will not only provide the total score but also determine the relative significance of each compounding SIR indicator. Finally, a special overview of performances of leading Indian universities is provided.

The article is organized as follows. We first give an overview of the SIR, THE and QS ranking methodologies. Then we describe the fundamental concept of the proposed I-distance method. This is followed by the results and concluding remarks.

Overview of SIR, THE and QS Ranking methodologies

One of the most cited ranking lists is the Academic Ranking of World Universities (ARWU), which has been the focus of researchers since its first creation in 2003 (refs 10, 11). However, a significant number of critical papers[12,13] paved the way for other ranking methodologies. One of the frequently elaborated characteristics of ARWU is the absence of the total score for universities above 100 ranks, thus making the university evaluation particularly difficult. In addition, less than a 100 Asian universities were included in the annual ARWU 2013. Keeping this in mind, we focused our attention to THE, QS and SIR methodologies since they have ranked and elaborated upon a far larger number of Asian universities.

The Times Higher Education and Quacquarelli Symonds published jointly the World University Rankings between 2004 and 2009. After their collaboration had ended, each party continued to publish its own rankings. Since they originally collaborated on the subject, these two methodologies have some similarities to say at least.

The Times Higher Education World University Rankings is considered to be 'the only global university performance tables to judge research-led universities across all their core missions – teaching, research, knowledge transfer and international outlook'[14]. Its ranking methodology is formed on '13 carefully calibrated performance indicators to provide the most comprehensive and balanced comparisons, which are trusted by students, academics, university leaders, industry and governments'[14], with those performance indicators grouped into five areas: (i) teaching: the learning environment (worth 30% of the overall ranking score); (ii) research: volume, income and reputation (worth 30%); (iii) citations: research influence (worth 30%); (iv) industry income: innovation (worth 2.5%), and (v) international outlook: staff, students and research (worth 7.5%). One of the foundations of THE and QS methodologies is the inclusion of teaching indicators into the ranking methodology. Since many 'rankings largely ignore one of the major components of what faculty do – teaching'[15], this inclusion was praised immensely. Nonetheless, measures such as reputational surveys, student satisfaction surveys, staff-to-student ratios, the doctorate-to-bachelor's ratio, and the number of Ph Ds held per staff member, are, at best, stand-ins for teaching quality and do not provide an accurate picture of what actually happens in the lecture hall[15]. The research performance of each university is evaluated through three indicators, with the most prominent one evaluating the university's reputation[14] for research excellence among its peers (based on the annual academic reputation survey). This category also looks at university research income, scaled against staff numbers and normalized for purchasing-power parity. Finally, the 'research' category also includes the number of papers published in the academic journals indexed by Thomson Reuters per academic, scaled to a university's total size and also normalized for a subject. The 'citations' category, on the other hand, is solely based on one indicator which looks at the role of universities in spreading new knowledge and ideas[16]. Consequently, the research influence has been evaluated by capturing the number of times a university published paper[14] is cited by scholars globally (Thomson Reuters examined more than 50 million citations to 6 million journal articles, published over five years). The final two areas, industry income and international outlook, tend to showcase the diversity of the campus and to what degree academics collaborate with international colleagues on research projects; but they also give a picture of the university's ability to help industry with innovations, inventions and consultancy[14].

The QS University Rankings – Asia[17], on the other hand, is based on the nine indicators: academic reputation (30%), employer reputation (10%), faculty–student ratio (20%), citations per paper (15%), papers per faculty (15%), proportion of international faculty, international students, inbound exchange students and outbound exchange students (2.5% each). As we can see, it has obvious similarities with the THE approach, and it also forms a final score based on all nine indicators which are weighted by subjectively chosen factors. Academic and employer reputation are obtained from the global survey. Results are based on the responses to surveys distributed to worldwide academics from a number of different sources, such as previous respondents, academia, Mardev-DM2, etc.[17]. The faculty–student ratio is calculated using

the full time equivalent student and full time equivalent faculty. Papers and citations are evaluated taking into account the size of the institution. These are the best understood and most widely accepted measures of research strength. They are focused on the performance of the papers from an institution which are actually indexed in *Scopus* – rather than Thomson Reuters as in THE methodology[17]. The international faculty index is simply based on the proportion of international faculty members. Similarly, the international students index is based on the proportion of international students. In the QS University Rankings – Asia, two additional indicators are incorporated based on the number of inbound and outbound students as a proportion of the student body carrying weight of 2.5% each and facilitating the picture of internationalization in Asia[17].

In contrast to these two approaches, a larger percentage of ranking methodologies mostly focuses on scientific performance of universities. Such is the SIR methodology, which ranks universities according to one quantitative and various qualitative indicators of scientific achievements. Output (O) indicator is a measure of the quantity or size of the publication output of an institution. It represents the total number of documents published in scholarly journals indexed in *Scopus*[18]. Seven other variables represent the quality dimension of scientific output[19]: international collaboration (IC), normalized impact (NI), high quality publications (Q1), specialization index (SI), excellence rate (ER), scientific lead (lead) and excellence with leadership (EwL). IC represents the output ratio of an institution produced in collaboration with foreign institutions[20]. Further, NI compares the average scientific impact of the institution with the world average. Also, Q1 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 quarter (25%) in their categories as calculated by SCImago Journal Rank[21]. SI indicates the extent of thematic concentration/dispersion of scientific output of an institution. On the other hand, ER indicates the percentage scientific output of an institution that is included into the set formed from 10% of the most cited papers in their respective scientific fields[22]. Scientific lead indicates an institution's 'output as main contributor', that is, the number of papers in which the corresponding author belongs to the institution[23]. Finally, EwL indicates the number of documents in the excellence rate in which the institution is the main contributor[24].

One of the major subjects that the SIR methodology is not able to provide is the total score and the appropriate rank. Our I-distance approach will offer a possible solution to this problem. In addition, by examining all five SIR World Reports, the crucial indicators in the process of ranking would be determined and weighting factors could be implemented. Moreover, subjectively chosen weights in QS and THE methodologies will be addressed and potentially improved in order to overcome subjectively chosen weights.

THE I-distance method

The common problem with different ranking methods is that possible biases and subjectivity can affect measurements and evaluation. This can somewhat be overcome using the I-distance method, a metric distance in an n-dimensional space[5,13]. It was originally defined by Ivanovic, who devised this method to rank countries according to their level of development based on several indicators, where the main issue was how to use all of them in order to calculate a single synthetic indicator, which would thereafter represent the rank[13].

For a selected set of variables $X^T = (X_1, X_2, \ldots X_k)$ chosen to characterize the entities, the I-distance between the two entities $e_r = (x_{1r}, x_{2r}, \ldots, x_{kr})$ and $e_s = (x_{1s}, x_{2s}, \ldots, x_{ks})$ is defined as[25]

$$D(r,s) = \sum_{i=1}^{k} \frac{|d_i(r,s)|}{\sigma_i} \prod_{j=1}^{i-1} (1 - r_{ji.12\ldots j-1}),$$

where $d_i(r, s)$ is the distance between the values of variable X_i for e_r and e_s, e.g. the discriminate effect

$$d_i(r,s) = x_{ir} - x_{is}\ i \in \{1,\ldots,k\},$$

σ_i is the standard deviation of X_i, and $r_{ji.12\ldots j-1}$ is a partial coefficient of the correlation between X_i and X_j, $(j < i)$[25].

In order to overcome the problem of negative coefficient of partial correlation, which can occur when it is not possible to achieve the same direction of movement for all variables[11], it is suitable to use the square I-distance. It is given as

$$D^2(r,s) = \sum_{i=1}^{k} \frac{d_i^2(r,s)}{\sigma_i^2} \prod_{j=1}^{i-1} (1 - r_{ji.12\ldots j-1}^2).$$

The I-distance measurement is based on calculating the mutual distances between the entities being processed, whereupon they are compared to one another, so as to create a rank. It is necessary to fix one entity as the reference in the observing set using the I-distance methodology. The ranking of entities in the set is based on the calculated distance from the reference[26].

Results of the I-distance method for SIR methodology

In the present study, all five releases of the SCImago World Reports[24] have been analysed and for each year the top 200 Asian higher education institutions (HEIs) have

Table 1. Results of the square I-distance method for Asian higher education institutions (HEIs) provided in SIR World Report (first 10 HEIs for 2013 and leading Indian HEIs)

HEI	Country	Rank I-distance				
		2009	2010	2011	2012	2013
Nanyang Techn. Univ.	SGP	6	6	6	2	1
The HK Univ. of Sci. and Techn.	HKG	2	1	1	1	2
Nat. Univ. of Sing.	SGP	3	3	3	3	3
City Univ. of HK	HKG	4	4	4	5	4
The HK Polyt. Univ.	HKG	5	5	5	4	5
Univ. of Tokyo	JPN	1	2	2	6	6
Tsinghua Univ.	CHN	8	7	7	7	7
The Univ. of HK	HKG	9	8	8	8	8
Pohang Univ. of Sci.and Techn.	KOR	12	10	9	9	9
The Chinese Univ. of HK	HKG	15	14	12	11	10
IIT, Roorkee	IND	25	18	16	18	19
IIT, Kharagpur	IND	17	17	18	20	24
IIT, Kanpur	IND	10	15	19	24	28
IISc, Bangalore	IND	36	32	32	34	34
IIT, Madras	IND	22	20	20	27	36
IIT, Bombay	IND	29	35	34	32	38
IIT, Delhi	IND	18	23	22	35	39

been selected. The results achieved by means of the square I-distance method and the top 10 HEIs in the year 2013 are shown in Table 1 (the full list for all of the analyses performed is available with the authors on request).

As can be seen from Table 1, Nanyang Technological University (NTU), Singapore is the best ranked for the year 2013. It showed great progress in 2012, and finally occupied the top spot in 2013. As seen from the table, the positions are more or less consistent over time. Particularly interesting is a huge leap from sixth to first place in 2013 for NTU with significant progress in almost all of the indicators observed. On the other hand, University of Tokyo, Japan fell to sixth place in 2012 with several indicators having smaller values than the 2011 edition. Interestingly, if the official ranking for the year 2013 was determined solely on the basis of the indicator 'output' (total published papers), NTU would rank as 16th with 22,185 published papers. A similar conclusion could be drawn for Hong Kong University of Science and Technology (HKUST), with 9618 published papers. Thus, it is essential to elaborate other variables in which NTU and HKUST demonstrate excellence. For instance, according to the quality indicator excellence with leadership (EwL, 13) and excellence rate (ER; 19.76), NTU is one of the best universities (number one according to EwL and third according to ER). The same observation could be made for HKUST with impressive values for EwL (12.1) and ER (21.13). A similar conclusion has been drawn by Radojicic and Jeremic[13], with regard to Rockefeller University (a postgraduate-only institution) which also had a small number of published papers, but showed excellent quality indicators such as Q1 (88.6%) and ER (48.8).

Consequently, it is essential to determine which of the eight input indicators are most important for the process of ranking. Thus, dataset was further examined and the correlation coefficients of each variable with the I-distance values were determined for each observed year. The results shown in Table 2 demonstrate that the most significant variable for the calculated I-distance value is EwL. This correlates highly with the I-distance value for the year 2013 ($r = 0.833$, $P < 0.01$). Also, excellence rate, normalized impact, international collaboration and output, are all important indicators, each with correlation larger than 0.500 ($P < 0.01$). As we can see, the correlations of each compounding SIR indicator are quite similar in the observed five-year period. These correlations that could easily become foundations for the creation of weighting factors and appropriate total score framework.

More in-depth analyses are needed in order to elaborate the strength and weaknesses of leading Indian universities. As we can see in Table 1, for each year a considerable number of Indian HEIs fall in the top 40. An overview of values for each Indian university and the three most significant indicators are given in Table 3. As we can see the Indian Institute of Science (IISc), Bangalore by far the most consistent university while all the other Indian HEIs have had a significant downfall in the world rankings. For almost every single indicator Indian universities have shown reduced values. This is particularly the case for EwL which appears to be the most significant indicator in the process of ranking. As already reported[27,28], the quality proxy of top Indian institutions is considerably low compared to the world institutions with comparable output, and significant efforts should be made to overcome this gap. In addition, one should note that essential science indicators identify all IITs as a single institution,

Table 2. Correlation between input variables and I-distance values for SIR methodology

	r				
	2009	2010	2011	2012	2013
Excellence with leadership (EwL)	0.787	0.793	0.791	0.814	0.833
Excellence rate (ER)	0.670	0.667	0.664	0.692	0.713
Normalized impact (NI)	0.515	0.516	0.504	0.529	0.546
International collaboration (IC)	0.499	0.478	0.469	0.515	0.527
Output (O)	0.526	0.514	0.516	0.512	0.520
High-quality publications (Q1)	0.218	0.225	0.242	0.261	0.305
Specialization index (SI)	0.074	0.068	0.051	0.081	0.109
Scientific lead (Lead)	0.152	0.146	0.122	0.092	0.054

Table 3. Comparison of leading Indian universities for the three most important indicators in SIR methodology according to the I-distance approach

	EwL		ER		NI	
Institution	2009	2013	2009	2013	2009	2013
IIT, Roorkee	10.35	9.55	14.45	13.03	1.09	1.01
IIT, Kharagpur	11.23	8.97	14.53	11.78	1.07	1.04
IIT, Kanpur	11.99	8.01	15.99	10.87	1.20	0.99
IISc, Bangalore	8.50	7.90	12.51	12.27	1.03	1.05
IIT, Madras	9.81	7.96	13.56	11.14	1.06	0.93
IIT, Bombay	8.85	7.50	13.70	11.99	1.10	1.12
IIT, Delhi	11.04	7.93	14.75	12.45	1.14	1.03

which makes it even more difficult to provide in-depth analysis of the leading Indian IITs[29].

Results of the I-distance method for QS and THE ranking methodologies

The I-distance procedure was employed on QS University Rankings Asia 2012 and 2013 datasets (only universities with the data for each of the indicators were examined) and THE Asian Top 100 Universities in 2013. The results of the square I-distance method for the Top 10 HEIs are shown in Table 4.

Since QS and THE ranking methodologies have some similarities in their approaches, it is also reflected in similar final rankings. However, when observing solely Indian institutions, their appearance is rather scarce and unconvincing. As a reasonable justification, one could say 'that the criteria adopted by THE were not justified for Indian universities as they excluded universities that did not teach undergraduates, taught narrow subjects and the research output was less than 1000 published articles between 2006 and 2010. It is to be noted that most of the Indian universities do not teach undergraduates, and universities teaching agriculture, law, medicine and engineering were not taken into account'[30]. Also, IISc 'has taken the number one position in a new ranking of the top 10 Indian higher education institutions based on their global academic prestige'[31]. However, it is not even included into THE Asia Top 100 Universities due to THE regulations previously elaborated. Thus it is of importance for Indian universities to focus on THE and QS methodologies and consequently improve their rankings. In addition, there should be greater focus on the most important indicators (those with highest weight score in official ranking methodology). The question should be raised whether those weights are based on sound grounds and a statistical approach towards achieving impartial rankings must be employed. Correlation between indicators and obtained I-distance values provides an underlying dynamics of the ranking procedure (Table 5).

The official rankings are based on the subjectively chosen weighting factors, while I-distance first integrates the most important variable for the process of ranking (the one that provides the largest amount of information on the phenomena that are to be ranked) and then the rest of the indicators. In the case of QS–Asia rankings, international faculty and students indicators ($r = 0.704$ and $r = 0.710$ respectively, $P < 0.01$, year 2013) are far more important than just 2.5% of the weights which are given in the official QS ranking methodology. On the other hand, indicators like international outlook and industry income are far more important than the THE methodology gives them credit. It is essential for THE and QS policy makers to perform more in-depth analyses and potentially revise their methodology concerning the nominal weighting factors.

Table 4. Results of the square I-distance method for HEI provided in QS University Rankings Asia 2013 and 2012 and THE Asia 2013 (first 10 HEIs for 2013 and leading Indian HEIs)

		QS Asia				THE Asia
HEI	Country	2012 Rank I-distance	2013 Rank I-distance	HEI	Country	2013 Rank I-distance
The HK Univ. of Sci. and Techn.	HKG	1	1	Nat. Univ. of Sing.	SGP	1
Nat. Univ. of Sing.	SGP	3	2	The Univ. of HK	HKG	2
The Univ. of HK	HKG	2	3	Nanyang Techn. Univ.	SGP	3
City Univ. of HK	HKG	6	4	POSTECH	KOR	4
The Chinese Univ. of Hong Kong	HKG	4	5	The Univ. of Tokyo	JPN	5
Seoul Nat. Univ.	KOR	5	6	Peking Univ.	CHN	6
Nanyang Techn. Univ.	SGP	9	7	The HK Univ. of Sci. and Techn.	HKG	7
Peking Univ.	CHN	7	8	Tsinghua Univ.	CHN	8
POSTECH	KOR	8	9	KAIST	KOR	9
KAIST	KOR	10	10	Seoul Nat. Univ.	KOR	10
IIT, Delhi	IND	56	54	IIT, Kharagpur	IND	43
IIT, Bombay	IND	55	58	IIT, Bombay	IND	56
IIT, Madras	IND	74	69	IIT, Roorkee	IND	57
IIT, Kanpur	IND	–	65			

Table 5. Correlation between input variables and I-distance values for QS Asia and THE Asia rankings

	r			*r*
Input variable	QS Asia 2012	2013	Input variable	THE Asia 2013
International students	0.666	0.710	Research	0.768
International faculty	0.567	0.704	Teaching	0.715
Faculty–student	0.774	0.682	Citations	0.676
Academic reputation	0.694	0.651	International outlook	0.562
Employer reputation	0.649	0.610	Industry income	0.467
Inbound exchange	0.583	0.550		
Papers per faculty	0.566	0.491		
Outbound exchange	0.502	0.477		
Citations per paper	0.516	0.457		

Concluding remarks

An increasing number of the world's best university ranking methodologies is forcing the academic world into becoming more and more concerned with the assessment of higher education. As these rankings are often used as a marketing tool by universities to showcase their educational or research excellence, the necessity to provide rankings as accurate as possible becomes exceptionally important[13]. As a possible answer to this issue, the analysis we presented here has stressed upon potential improvements of the SIR, THE and QS ranking methodologies. First, the approach enabled us to present ranks in SIR list taking into account all eight indicators (not just one as proposed in the SIR official rankings). In addition, a new perspective on problems with subjectively chosen weighting factors in THE and QS rankings has been elaborated and possible improvements have been suggested out. Finally, using the I-distance approach we were able to provide an insight into problems of selecting appropriate indicators of excellence. It is obvious that methodologies present an essential part of each ranking list and additional effort must be made in order to get more impartial results. Further potential approaches could be directed towards integrating indicators of other methodologies such as Leiden ranking[32], which showed some similarities with SIR (in terms of bibliometric data, ranking focus on the research performance of institutions). The Leiden ranking by default reports size-independent indicators (average statistics per publication, such as a university's average number of citations per publication) and the advantage is that they facilitate comparisons between smaller and larger universities[33]. In addition, new approaches in creating scalar indicators derived from standard indicators such as impact, citations and number of papers[34], could be a catalyst for further development in this interesting area of research.

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