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Demystifying university rankings and their impact on reputation among consumers of higher education

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Abstract:
Purpose: *Several universities in different countries are using their college ranking as a marketing and branding tool. Main scope of this paper is to investigate the interrelation between college rankings in Korea and how they affect university service marketing and reputation.*
Methods: *Forty-six universities are examined through a non-parametric technique, by comparing three different Data Envelopment Analysis (DEA) models regarding their adeptness to their Research and Development Business Foundation; parametric methods used to measure efficiencies in the public or private sectors are Ratio Analysis, Productivity Index Approach and Functional Approach.*
Results: *The results delineate that the three model have different results since CCR and BCC models have better efficiency scores compared to SBM. Furthermore, public universities with local character seems to have better decision-making units leading to better branding.*
Implications: *Decision makers can enhance policies by improving the effectiveness and antagonism of Research and Development Business Foundations, to improve university's reputation and attract more and better students. In spite of some valid considerations regarding the ranking of educational institutions in the world, ARWU (Academic Ranking of World Universities) is still a useful indicator for universities who wish to grow further, and will remain as a good guideline.*

Keywords: *university branding, university ranking, World Universities Ranking System, Korea, DEA*

JEL Classification: *A2, MOO, M3*

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1 INTRODUCTION

One of the contemporary issues universities are seeking to deal with, is intensive marketing programs with dual interrelation, initially to improve university's reputation and attract more student and then affect progressively their ranking (Bunzel, 2007). As Valitof (2014) indicates that by branding universities a competitive advance can be achieved, and a better marketing share will be attainted as it is easier to sustain a loyal audience with great benefits for the university. Changes in national policies due to the decrease in school aged population has caused structural innovation in institutes of higher educational, where universities are expanding their educational systems to participate in global higher education by inviting foreign students, dispatching students or teaching staff to educational institutions abroad, establishing cooperative relationship with foreign universities, and/or intensifying global research efforts (Perchinunno & Cazzolle, 2020). Restructuring efforts of educational institutions in the stream of globalization are in some way represented by the 'Rankings of World Universities' provided by several institutions in the world. This system stimulates world universities to react upon these indicators somehow by establishing dedicated assessment teams or institutions.
The types of universities ratings are broadly classified into 'Accreditation' and 'Ranking.' 'Accreditation' is an assessment of the quality of an educational institution, achieved by examining educational or research conditions (or competence), or the overall performances of institutions (Rybinski, 2020). Accreditation is normally employed to select institutions to provide financial support, or to identify inadequate universities (Fu & Kapiki, 2016; Andreani et al., 2020). 'Ranking' typically reveals the relative ratings of subject universities, where weighted points are assigned to

individual indicators, which contribute to the aggregated total scores (ratings) by which the relative orders of assessment are created. The quantitative ratings obtained through objective statistical data, peer reviews, or questionnaires from the people in charge of corporate human resources are typically employed to assess the relative ratings, as in the case of current world university ranking systems.

The origin of university ranking was the 'Ranking of Universities in America' presented by the US News & World Report in 1983. Since then, several reports of domestic university rankings have been reported. The 'University League Tables' of the 'Guardian' in England and the 'Maclean's University Rankings' in Canada, or the 'Domestic Universities Ranking in Korea' from JoongAng Daily in Korea are examples of such reports. The Academic Ranking of World Universities (ARWU) from the Center for World-Class Universities of Shanghai Jiao Tong University, the World University Ranking from Quacquarelli Symonds (QS), the Times Higher Education (THES) of 'the Times' in England, and the Webometrics from Spain also reported the ranking of world universities, together with HEEACT (Higher Education Evaluation & Accreditation Council of Taiwan) and Leiden University in the Netherlands. However, such reports have simply provided relative rankings of universities, and lack effective information for universities to gain an understanding of their relative deficiencies (Nair & George, 2016). On the other hand, 'Accreditations' focused on multi-dimensional ratings enables the provision of bench-marking information or SWAT analysis of institutions.

Several scholars have raised questions on such university rankings, proposing that they lack sufficient information for individual institutions to achieve further improvement. They also stated the problems, along with the appropriateness of such rankings, as they have been prepared with different objectives and/or methods in selecting indicators and assigning the weighted scores.

The 'Seoul National University Faculty Council' once expressed an opinion on the world rankings from among two of the institutions above, stating that "…the rankings from Shanghai Jiao Tong University weighed too much upon past reputation (= the awards of Nobel prizes) of educational institutions, and gave relatively higher ratings to science and engineering departments with unreasonable approaches in considering the scale of institutions…". Regarding the ratings from 'the Times', the council also commented that "…they replaced the results from relative ratings upon reputation of universities…; … and lacked the proven objectivity of rating upon groups of specialists and scholars in various specialized disciplines over the world…" (The Professors Times; 2005).Various other concerns have also been raised, including the following: that '…the world university ranking systems have been designed to be advantageous to universities placed in certain countries such as America or Japan, and to be disadvantageous to non-English spoken countries…'; that '…the systems attached relatively high weights to research oriented institutions and alienated small scaled or education oriented specialized institutions…'; or that '…the system had problems securing the validity of their selected core indicators and the appropriateness of weights, along with wide fluctuation in rankings…' (Christou, 2002; Drill et al., 2005; Altbach, 2006; Taylor, 2008; Kim Hoon-Ho et al., 2010; Nam Soo-Kyeong et al., 2012; Tsagaris et al., 2018; Gedviliene, 2020).

Institutions reported that those who report world university rankings seem to have tried to improve the methods in their rating systems, but a universal standard applicable for the rating of diverse global universities would not be easy to establish with the difficulties in securing normalized data or information. Therefore, this study was designed to understand the problems in the original world university rating system, the ARWU, through empirical examination of the related issues and factors to determine appropriate improvements. The DEA/AP model enabled assessment of the relative efficiencies in each DMU to suggest its validity as an alternative to obtain global universities rankings.

2 THEORETICAL BACKGROUND

2.1. Academic Ranking of World Universities

Currently, the ranking of global universities is determined by comparing ratings about the comprehensive capabilities of universities, obtained from indicators of individual rating methodology which are prepared and publicized by several institutions. There are about 20,000 universities in the world today, and about 15,000 of them have been rated by Webometries in Spain. Most institutions reporting the rankings of world universities have used a scale from 100 to 1000 educational institutions.

Categories for the ranking of educational institutions can be classified into competitiveness, academic capability, and others (Christou & Chatzigeorgiou, 2019). Depending upon the range of subject universities, they can also be classified into domestic, regional, or global rankings (Lee, Yeong-Hak, 2007).

The representative university rankings rating the global competitiveness of universities are the 'ARWU' adopted in this study, the 'World University Rankings' from QS (England), and 'The World University Ranking' prepared by the collaboration of THES and Thomson Reuters (England). The 'ARWU', generated by the Center for World-Class Universities of Shanghai Jiao Tong University, is a raking based on representative quantitative research capability. In contrast, the World University Rankings of QS and The World University Ranking of THES & Thomson Reuters are hybrid multi-dimensional ratings, which employ both quantitative & qualitative analyses of indicators representing education, R&D, and globalization.

The ARWU was originally prepared for the internal purpose of comparing the research competence of Chinese universities with global universities. It is generated using 6 indicators in the following 4 fields: quality of education, quality of faculty, research performance, and scale of (educational) institution.

QS reported the rankings of universities from 2004 to 2009 in collaboration with THES, and several reports have been prepared since 2010. Originally, QS introduced the report as a means to provide information on higher education and globalization of educational institutions to students of higher education around the world. QS employed 4 competence factors to generate the rankings: research (60%), alumni (10%), globalization (10%), and education (20%).

Information collected from the people in charge of corporate human resources has relatively higher weight in this rating system. Research performance of a university is rated by the number of citations of the papers per professor and assessments of academic specialists, while the level of globalization is rated by the ratio of domestic & foreign professors and students. The number of students per professor and/or other detailed indicators are employed to rate the educational conditions.

The primary standard scores calculated from the natural logarithm of the collected points are converted into percentiles on normal distribution to get ratings for the ranking. THES has provided analysis and information on global higher education since 1971, and has provided the world universities rankings together with QS since 2004. Since 2010, the separate university rankings have been provided in collaboration with Thomson & Reuters. For quantitative rating, THES added ‘Research Funds’ to the existing indicator, the number of papers published in international journals. For qualitative assessment of research, indicators such as ‘Peer Reviews’ and ‘Citation of Papers’ were combined together. THES provides consulting services regarding the various indicators to rate overall aspects of education and research in universities, and receives opinions from universities to help create an unbiased and integrated rating of world universities.

Table 1: Major institutions issuing the Global Academic Ranking of World Universities

Institutions	Descriptions	Rating Fields & Weights
ARWU	. Year of Initiation: 2003 . Country & Institution: Shanghai Jiao Tong University, China . Publication: Mid-August . Rankings: 500 Universities (Publicizes Top 100 Universities and 500 Universities in bound groups of 50 consecutive rankings)	. Quality of Education (10) . Quality of Faculty (40) . Research Output (40) . Per Capita Performance (10)
QS	. Year of Initiation: 2004 . Country & Institution: Quacquarelli Symonds, England . Publication: Beginning of September . Rankings: Over 700 Universities (Publicizes Top 400 Universities)	. Educational Conditions (20) . R&D (60) . Alumni Reputation (10) . Degree of Globalization (10)
THES	. Year of Initiation: 1971 (the Originator), Co-authored with the Thomson & Reuters since 2010 . Country & Institution: Times Higher Education, England . Publication: Beginning of October, Beginning of April (for Asian Universities) . Rankings: 400 Universities (Publicizes Top 200 Universities)	. Educational Conditions(30) . Degree of Globalization (7.5) . Earnings from Knowledge Transfer (2.5) . R&D(30) . Number of Citation of Papers (30)
Webometrics	. Year of Initiation: 2004 . Country & Institution: CSIC (The Spanish National Research Council), Spain . Publication: January & June . Rankings: Publicizes 15,000 Universities	. Visibility(50%) . Size(20%) . Rich Files(15%) . Scholars (15%)
Leiden	. Year of Initiation: 2008 . Country & Institution: Center for Science and Technology Studies, Leiden University, Netherlands . Publication: July . Rankings: Publicizes 250 Universities (based on 4 Indicators) and 500 Universities (Based on 5 Indicators)	. Number of Published Papers (20) . Number of Citations of Papers(20) . Number of Citations per Paper (20) . Number of Citation of Papers (Each Subject Field) (20) . Number of Citation of Papers (Individual Subjects) (20)
HEEACT	. Year of Initiation: 2007 . Country & Institution: Higher Education Evaluation & Accreditation Council of Taiwan, Taiwan . Publication: August . Rankings: 500 Universities	. Quantitative Productivity of R&D (20) . Qualitative Influence of R&D (30) . Excellence of R&D (50)

The fields used to rate universities were classified into ‘Research’, ‘Education’, ‘Globalization’, and ‘Research Funds from Industries’ in the THES system. The highest weight of 62.5% was assigned to the ‘Research’ field, which consisted of indicators such as research reputation, number of papers published internationally, amount of research funds, and number of citations per published paper. Among indicators, the number of citations per published paper occupied a significant weight at 32.5%.

For the THES assessment of the field of ‘Education’, indicators such as the number of teaching staff with a doctorate, the number of students enrolled in undergraduate school, and the research funds are included. The ratio of foreign teaching staff and foreign students are indicators included in the field of ‘Globalization’. The indicator representing the research funds per teaching staff is included in the field of ‘Research Funds from Industries’. To obtain points for the rating, the percentiles are calculated based on normal distribution derived from Z-scores (Yeom Dong-Gi et al., 2013). The ranking systems of QS, THES and other institutions including ARWU are summarized and compared in Table 1.

2.2. Academic Ranking of World Universities (Shanghai Jiao Tong University List)

The ARWU (Academic Ranking of World Universities) has been publicized every year since 2003.The report is prepared independently by Shanghai Ranking Consultancy in the Center for World-Class Universities of Shanghai Jiao Tong University, without external aid of financial backing. The Center for World-Class Universities (CWCU) initially started this work to determine the global standing of the top Chinese universities. Though they have made some minor adjustments in the composition and rating method of indicators included in the rating of Academic Rankings, the initial idea to assess the competitiveness in academic research has remained unchanged. Data from each university for the ARWU rating are not used directly, but instead, indirectly acquired data related to SCI(E) or SSCI from the Web of Science, along with those from external institutions such as for Nobel Prize or Fields Medal Prizes are used for the rating of rankings of each university.

Data related with SCI(E) or SSCI are pre-analyzed to assign ratings in accordance with the results, and are validated thereafter for causes of error to be corrected for in next year's ratings by the post assessment system in CWCU (Center for World-Class Universities). The ARWU is mainly generated from 6-indicators in 4 fields, consisting of ‘Quality of Education (10%)’, ‘Quality of Faculty (40%)’, ‘Research Output (40%)’, and ‘Per Capita Performance (10%)’. The total number of the alumni of an institution who were awarded the Nobel Prizes or Fields Medal Prize are included as indicators to rate the ‘Quality of Education’. Alumni are defined as those who obtained Bachelor’s, Master's or Doctoral degrees from the institution.

The amount of highly cited scholars is added to the quantity of alumni awarded Nobel Prizes or Fields Medal Prize for assessment of the ‘Quality of Faculty’, and research outputs are determined by how many research papers were published in journals such as ‘Nature’ and ‘Science’, along with those listed in SCI & SSCI. ‘Per Capita Performance’ indicates the sum of the scores of the 5 weighted indicators divided by the number of teaching staff. In the case that the number of teaching staff in an institution is unknown, it indicates only the scores of the 5 indicators. To provide the ranking, the institution earning the highest score will get 100 points, and the comparative percentage points are assigned to the rest of the institutions based on the summed points obtained from the multiplication of each weight.

In the Academic Rankings listed since 2007, the global top 100 institutions were selected by ratings in the following fields: Natural Science; Mathematics; Mechanical, Technical, and Computer Science; Life & Agricultural Science; Clinical Medicine & Pharmacology; and Social Science.

The number of 'Alumni' who obtained Bachelor's, Master's or Doctoral degrees from each institution are included as indicators to rate the ARWU; a weight of 100% is assigned to alumni obtaining such degrees from 2001-2010, a weight of 90% for those who obtained such degrees from 1991-2000, 80% for the years 1981-1990, and so on, down to 10% for the years 1911-1920. The number of alumni who obtained multiple degrees in each institution was counted only as 1.

Number of winners of the Nobel Prizes in Physics, Chemistry, Medicine, and Economics, and those of Fields Medal Prize in Mathematics are included as indicators for the rating of ARWU. Similar to alumni mentioned above, a weight of 100% is assigned to staff awarded such prizes since 2011, 90% for those from 2001-2010, 80% for thosefrom 1991-2000, and so on, down to 10% for those from 1921-1930.

Table 2: Indicators and Weights Configuring the ARWU

Indicators	Descriptions	Field	Weight
Alumni Awards of Nobel and Fields Medal Prize	Number of alumni awarded the Nobel or Fields Medal Prizes	Alumni	10%
Professors / Faculty Awards of Nobel and Fields Medal Prize	Number of members of faculty awarded the Nobel or Fields Medal Prizes	Award	20%
Researchers of Highly Cited Indices	Number of highly cited researchers in 21 academic disciplines	HiCi	20%
Publications in Nature and Science	How many academic contributions were published in Nature and Science	N&S	20%
SCIE, SSCI	How many academic contributions were listed in SCI(E) & SSCI	PUB	20%
Per Capita Performance	Institute per capita scientific performance	PCP	10%

'HiCi' is an indicator to rate the number of researchers whose papers in 21 academic disciplines were highly cited. 'N&S' implies the number of papers published in the journals 'Science' and 'Nature' in 2008-2012. If an authors is the first author of the paper he is weighted 50%, then 25% is assigned for the following author, and 10% for the last author. Another index is 'PUB' which included the total amount of manuscripts are included in Science Citation Index-Expanded and Social Science Citation Index. The weighted scores of Alumni, Awards, HiCi, N&S and PUB are divided by the number of permanent academic employees to calculate the PCP. If the total of permanent personel in each institution cannot be found, then the weighted totals of the five indicators are used. Indicators and corresponding weights used by ARWU are summarized in Table 2.

2.3. Approaches to the rating of efficiency

The methods employing the parametric technique to measure efficiencies in the public or private sectors are Ratio Analysis, Productivity Index Approach and Functional Approach, while Data Envelopment Analysis employs the non-parametric technique (Kim, Jae-Hong et al., 2001).

Ratio analysis

Ratio analysis is basically performed to observe the ratio of two variables contained in financial statements of companies which were collected in each (fiscal) year, without any intended modification for the purpose of measuring efficiency. The line items in financial statement are compared with each other to produce corresponding financial ratios, which are employed to assess financial status or operational performance of each company compared to the absolute or average industrial standard ratios. Ratio analysis is widely used to evaluate various aspects of operating or financial performance of companies, such as profitability, liquidity, stability and/or growth, etc.

Productivity Index Approach

The Productivity Index Approach uses the productivity indices obtained from the value of output products divided by the input costs incurred by labor, capital, raw materials, and/or other expenses to measure efficiency. This method has the advantage of easy calculation, which enables mutual comparison of productivities of each input. However, it is not possible to calculate the economic effects of scale of economy or individual sectors with this method, as it would be difficult to measure pure productivity of price effects among the aggregation of inputs and outputs converted into monetary units. In addition, it would also be difficult to identify exact inefficient sectors to suggest practical operational improvements using this method.

Functional approach

The functional approach assumes the function of the parameters of cost and/or output to exploit statistical methods such as regression analysis. In regression analysis, the functional relation regularly observed between two parameters is examined. The regression model assumes a linear relationship between the independent and dependent variables to describe or predict aspects of the dependent variable.

Data Envelopment Analysis

Data Envelopment Analysis (DEA) is a non-parametric statistical method employing the modified shortcomings of efficiency evaluation for profit-making institutions. This is the linear programming method which was introduced by Charnes, Cooper, and Rhodes (1978:429-444) in the late 1970s. They interpreted the concept of efficiency of Ferrel (1957:253-281), who divided subject groups into efficient and inefficient ones in new ways, and expanded the methodology to the ratio model of multi-inputs and multi-outputs. The concept of efficiency presented by Ferrell was the value obtained from the sum of weighted output values divided by the sum of weighted input values, which enabled the measurement of respective efficiency to be represented by the distance from the efficient set.

The ratio concept of such single input versus single output was modified and expanded to handle multiple inputs and outputs by Charnes, Cooper, and Rhodes. This new model was named CCR, following their initials, and the method was named Data Envelopment Analysis (DEA). Later, the new BCC model was developed by Banker, Charnes, and Cooper (1984) to compensate for the shortcomings of the CCR model, which could not distinguish the efficiency of scale and pure technologies under the assumption of invariant scale revenue in each DMU. DEA reveals the relative efficiencies, where 100% efficiency is achieved when there are no grounds of inefficiency in the input and output of the respective DMU. The value of the efficiency rating (E) employed to assess organizations would be 1 if the corresponding DMU was as efficient as the model DMU, while values less than 1represent the inefficiencies of other DUMs.

Basically, the classical CCR and BCC models in DEA both have a critical problem in that they are unable to discriminate between the differences in efficiencies among efficient DMUs having efficiency rating values of 1. To compensate for this problem, the AP model (also called the Super-CCR model) was introduced by Andersen and Petersen (1989) (Eom, Jun-Yong, 2011:36). When too many observations have the same efficiency rating value of 1, the relative dominance among such observation points should be clarified. The super-efficiency model was introduced to solve such problems. This model derives the super-efficiency measurements by excluding subject DMUs as being efficient, and calculating the distances between the subject DMUs and the production frontiers newly created by using the rest of the DMUs. Therefore, the efficiency measurements calculated by the AP model would be the same as the inefficiency measurements calculated by the CCR model, causing the efficiency measurements of DMUs having efficiency rating values of 1 to be different from each other (Lee, Jeong-Dong, 2010).

2.4. Review of prior studies

Ahn et al. (1990), Ahn & Seiford (1993), Cyrii & Green (1988), and Johneset al. (1996) studied the application of DEA on the ratings from institutions which rated academic institutions. Ahn et al. (1990) employed the number of under-graduate students and credits as educational outputs; employed the number of graduate school students as the common output of education and research; and put the supportive funds of research as the research output. Ahn and Seiford (1993) employed the method applying the numbers of under-graduate and graduate school students as input and output variables using 2-stage analysis. Cyrii and Green (1988) applied the number of professors, number of staff members, and the labor cost as input variables, and the number of undergraduate and graduate school students, research funds, number of papers, and the number of books authored as output variables. Johnes (1996) adopted the rate of employment, the rate of earned degrees, and the rate of dropouts, etc., as the educational output variables, while applying the rankings in research fields in other institutions as the variables of research output. Finally, Marginson (2007), Kim et al. (2010), and Lee (2011) conducted studies applying comparative analyses on the issues and efficiency of the academic ranking of world universities.

The procedures, indicators, and subjects for the rating and ranking were mostly analyzed comparatively, and were discussed to extract improvement to the methods for rating and ranking. Marginson (2007) compared the ARWU and the THES method to examine the issues and political implications in the ranking of world universities. They found the two ranking systems did not consider given conditions, characteristics, and the scales of institutions. They also pointed two essential deficiencies: neglect of the characterized institutions in the small scale, and that the systems were configured to be advantageous to universities placed in English spoken regions. Studies conducted by Kim et al. (2010) and Lee (2011) obtained similar results, where Kim (2010) conducted a comparative analysis between THES and QS, while Lee (2011) carried out the comparative analyses between ARWU and the other systems of academic ranking of universities from QS, THES, and the Chosun Daily and Joongang Daily in Korea. However, studies performing comparative analyses of the rankings between continents and/or countries, between the scales of each institution, and upon changes in rankings are rare. Cases applying the newly suggested ranking methods were also not found. Thus, approaches to assess the effectiveness of the current ARWU methods and to provide solutions to the potential problems of the current methods by applying other analytical methods are required.

3 DESIGN OF THE STUDY

3.1. Subjects and Variables in the Study

The purpose of this study was to find the potential problems in ARWU, and to present corresponding corrective schemes by comparing, analyzing, and applying the relative efficiency, as summarized in Table 3. Therefore, correlations between the ratings resulting from ARWU were examined in three ways. The correlation between the 6 applied indicators and the total ranking of universities up to the top 500 by region and country over the past 3 years were examined, then the relationship between the results from ARWU and the DEA/AP model, along with PCP, were reviewed through cross-sectional analysis. Finally, relative efficiency assessment was applied to the 'Per Capita Performance' of each global university to make comparative analysis of the rankings from ARWU, which quantified the ratings of PCP of the universities and rankings measured from the AP model. The relative efficiency assessment method was applied to 'Per Capita Performance' of each university to compensate for the limitations of ARWU, which could not support a correct decision making policy or provide concrete information due to the result-oriented approach. The top 100 universities from ARWU 2013 were selected to compare the relative efficiencies with results of ratings by calculating the 'PCP'. Among them, a total of 48 universities, excluding those which had missing data or outliers, were finally selected for the analysis of relative efficiency. To conduct the Data Envelopment Analysis, the i) number of teaching staff,

ii) number of graduate school students, and iii) operational expenditures were selected as input variables.

Table 3: Subjects for comparative analysis of ARWU

Approaches	Subjects for Comparative Analysis
Global Regions and Individual Countries	-The top 500 universities over the past 3 years in each region and country -Global regions, classified into America, Europe, Asia/Oceania, and Africa -Examined 43 total countries, including the US, England, Korea, Japan, etc.
Analysis of correlation between global ranking and corresponding indicators	-Correlation analysis of global ranking and indicators over the past 3 years -Analysis of indicators (Alumni, Awards, HiCi, N&S, PUB, and PCP)
Analysis of Correlation between ARWU, AP, and PCP	-Analysis of correlation between results from ARWU (2013) and DEA/AP model, along with PCP -Generation of Rankings from DEA/AP model and analysis of control group and slack variables.

The indicators in ARWU were selected as the output variables [i) Alumni, ii) Awards, iii) HiCi, iv) N&S, v) PUB, and vi) PCP].. Since the DEA could only be enabled by the application of the sum of values of identical variables in input and output, the values of the variables from ARWU were borrowed. Along with the rating of relative efficiency of 'PCP' in each university through the DEA, the values of super-efficiency were calculated with the AP model to compare the values with ratings of 'PCP' in ARWU.
The input and output variables selected to rate relative efficiencies are described in Table 4 for calculation of the value of super-efficiency, and the calculated values were compared with the rankings of total points in ARWU.

Table 4: Indicators used for ranking of super-efficiency generated by AP model for rating of ARWU

Academic Ranking of World Universities	Data Envelopment Analysis Variables	
ARWU Ranking	Input variables	Output Variables
Total Ranking	Number of teaching staff, Number of graduate students, Operational Expenditures	Alumni, Awards, HiCi, N&S PUB, PCP

Input variables were obtained from annual reports or financial reports for the year 2012, along with information posted on the websites of each university. The output variables were adopted from ARWU 2013, issued by the Center for World-Class Universities of Shanghai Jiao Tong University.

3.2. Methods of analyses

Pearson's correlation analysis was employed to conduct comparative analysis of the results of ratings of ARWU over the past 3 years. The Minitab and SPSS 13.0 packages were used for processing of the statistical data. The differences in data of the 43 countries which had enrolled their universities in the top 500 of ARWU for the past 3 years were examined through content analysis. To rate relative efficiency, the DEA/AP model, which applied the sums of input and output variables, was employed to calculate the rankings of efficiency units through the derived values of the relative efficiency and super-efficiency of subject universities. The 'Banxia Software Frontier Analyst 4.0' and 'EnPAS' (= the applications to calculate efficiency and productivity) programs were employed to carry out the DEA analysis.

4 EMPIRICAL ANALYSIS

4.1. Empirical analysis of the rating system for ARWU

Comparative analysis by region

The top 500 universities in ARWU are summarized in Table 5, by global region. According to ARWU 2013, the top 20 universities included 17 universities in the USA, and 3 in Europe. Considering the top 100, 56 were in the U.S., and 33 universities were in Europe (Table 5). This includes both North and South America. If you want to focus on the USA, I suggest editing the numbers instead – I would say most people in South America are not native English speakers.

Table 5: Number of universities in the Top 500 by region (unit: year, count)

	Region	US	Europe	Asia /Oceania	Africa	Total
Top 20	11	17	3	-	-	20
	12	17	2	1	-	20
	13	17	3	-	-	20
Top 100	11	57	34	10	-	101
	12	57	31	12	-	100
	13	56	33	11	-	100
Top200	11	100	75	25	-	200
	12	95	75	30	-	200
	13	95	75	30	-	200
Top300	11	132	123	44	1	300
	12	130	123	46	1	300
	13	127	126	46	1	300
Top 400	11	162	158	72	2	400
	12	162	164	78	2	400
	13	156	164	78	2	400
Top 500	11	184	204	108	4	500
	12	182	202	112	4	500
	13	182	200	114	4	500

Looking wider into the top 200, 95 universities were in the Americas, and 75 were in Europe. This trend continued with 127& 116 for the top 300; 156 & 164 for the top 400; and 182 & 200 for the top 500. The occupancy of universities from the Americas and Europe was 76 ~ 100%. For the region of

Asia & Oceania, only Tokyo University was included in the top 20 of ARWU over the past three years. In the top 100, only 11% were in Asia & Oceania,with 15% for the top 200 & top 300, 20% for the top 400, and 23% for the top 500.This was only a half or one third of the universities in the USA and Europe. For Africa, Witwatersrand University was the only one included in the top 300, with 2 universities included in the top 400, and 5 in the top 500, demonstrating a comparatively inferior educational environment.

Table 6: Number of Top 500 universities in each country (unit: year, count)

Country/Year	Top20	Top100	Top200	Top300	Top400	Top500(Year, Counts)
Country/Year	11/12/13	11/12/13	11/12/13	11/12/13	11/12/13	11/12/13
United States	17/17/17	53/53/52	89/85/85	110/109/108	137/137/131	151/150/149
United Kingdom	3/2/2	10/9/9	19/19/19	29/30/29	33/33/33	37/38/37
Switzerland	0/0/1	4/4/4	6/6/6	7/7/7	7/7/7	7/7/7
Australia	0/0/0	4/5/5	7/7/7	9/9/9	13/16/16	19/19/19
Germany	0/0/0	6/4/4	14/14/14	23/24/23	32/30/30	39/37/38
France	0/0/0	3/3/4	8/8/8	13/13/16	17/16/18	21/20/20
Canada	0/0/0	4/4/4	8/7/7	18/17/16	18/18/18	22/22/23
Japan	0/1/0	5/4/3	9/9/9	10/9/10	16/16/15	23/21/20
Netherlands	0/0/0	2/2/3	9/8/8	10/10/10	12/12/12	13/13/12
Sweden	0/0/0	3/3/3	4/5/5	8/7/8	10/11/10	11/11/11
Israel	0/0/0	1/3/3	4/4/4	4/4/4	6/6/6	7/6/7
Denmark	0/0/0	2/2/2	3/3/3	4/4/4	4/4/4	4/4/4
Belgium	0/0/0	1/1/1	4/4/4	6/6/6	6/6/7	7/7/7
Norway	0/0/0	1/1/1	1/1/1	3/3/3	3/3/3	4/4/4
Finland	0/0/0	1/1/1	1/1/1	1/1/1	3/3/3	5/5/5
Russia	0/0/0	1/1/1	1/1/1	1/1/1	2/1/2	2/2/2
China	0/0/0	0/0/0	3/7/7	13/15/13	21/24/26	35/42/42
Italy	0/0/0	0/0/0	4/4/4	8/9/9	13/12/12	22/20/19
South Korea	0/0/0	0/0/0	1/1/1	3/4/4	7/7/7	11/10/11
Austria	0/0/0	0/0/0	1/1/1	3/3/3	5/3/3	7/7/7
Saudi Arabia	0/0/0	0/0/0	0/0/1	1/1/2	2/3/3	2/3/4
Singapore	0/0/0	0/0/0	1/1/1	2/2/2	2/2/2	2/2/2
Brazil	0/0/0	0/0/0	1/1/1	2/2/1	5/5/5	7/6/6
Argentina	0/0/0	0/0/0	1/1/1	1/1/1	1/1/1	1/1/1
Mexico	0/0/0	0/0/0	1/1/1	1/1/1	1/1/1	1/1/1
Spain	0/0/0	0/0/0	0/0/0	4/3/4	6/7/8	11/11/10
New Zealand	0/0/0	0/0/0	0/1/0	2/2/2	2/2/2	5/5/5
Ireland	0/0/0	0/0/0	0/0/0	1/1/1	3/3/3	3/3/3
South Africa	0/0/0	0/0/0	0/0/0	1/1/1	2/2/2	3/3/3
Czech	0/0/0	0/0/0	0/0/0	1/1/1	1/1/1	1/1/1
Portugal	0/0/0	0/0/0	0/0/0	0/0/0	1/1/2	2/3/4
Greece	0/0/0	0/0/0	0/0/0	0/0/0	2/2/2	2/2/2
Poland	0/0/0	0/0/0	0/0/0	0/0/0	2/2/2	2/2/2
Hungary	0/0/0	0/0/0	0/0/0	0/0/0	2/1/1	2/2/2
India	0/0/0	0/0/0	0/0/0	0/0/0	1/1/1	1/1/1
Serbia	0/0/0	0/0/0	0/0/0	0/0/0	1/1/1	1/1/1
Chile	0/0/0	0/0/0	0/0/0	0/0/0	0/0/0	2/2/2
Croatia	0/0/0	0/0/0	0/0/0	0/0/0	0/0/0	1/1/1
Egypt	0/0/0	0/0/0	0/0/0	0/0/0	0/0/0	1/1/1
Iran	0/0/0	0/0/0	0/0/0	0/0/0	1/1/0	1/1/1

The 43 countries with universities listed in the top 500 of ARWU are summarized in Table 6. For the top 20,excluding the universities in USA and the UK, 1 university in Japan and 1 in Switzerland were listed. The universities from 16 countries appeared in the top 100,including the US, the UK, Switzerland, Belgium, Norway, Finland, Russia etc. The top 200 contains universities of 25 countries, including Seoul National University in Korea, while universities from 36 countries were included in the top 400.

Table 7: Correlation between ARWU and indicators

Year	Correlation between Global Rankings and Indicators					
2013	N&S (0.922)	HiCi (0.869)	Award (0.837)	Alumni (0.789)	PCP (0.724)	PUB (0.595)
2012	N&S (0.923)	HiCi (0.867)	Award (0.834)	Alumni (0.786)	PCP (0.733)	PUB (0.593)
2011	N&S (0.924)	HiCi (0.868)	Award (0.839)	Alumni (0.766)	PCP (0.723)	PUB (0.593)

Results of the analysis of correlation between the indicators and ARWU from 2011 to 2013 are illustrated in Table 7. N&S appeared to be the most influential indicator in ARWU. The high relevance of the number of published papers in the journals 'Science' and 'Nature' suggested that active efforts for the publication of papers to such journals would improve the ranking. The order of the correlation between rankings and indicators for the past 3 years appeared as follows: N&S>HiCi>Awards >Alumni>PCP>PUB. 'PUB', allotted 20% of the weight, implies the number of published papers listed in SCI(E) and SSCI; however, it revealed the lowest correlation with the ranking, despite its relatively high weight, which suggests that the difference between the number of published papers listed in SCI(E) and SSCI for each university is likely ignorable. The 'Awards' category represented the number of alumni awarded the Nobel or Fields Medal prizes. This was expected to have a relatively high influence upon the ranking, but appeared to have a relatively low correlation with the ranking. However, analysis of the top 100 universities revealed that only two of those ranked in the top 100,namely California Davis (top 40) and Texas A&M (top 90),did not have alumni awarded the prizes, which probably suggests that this condition was essential for universities to be included in the top 100 in the ARWU ranking.

4.2. Analysis of relative efficiency

Descriptive statistics

Descriptive statistics of the 48 universities analyzed for efficiency were obtained from measurements using indicators such as the number of teaching staff, the number of graduate school students, and the operational expenditures of universities.

These statistics, connected to the output measurements of the top 100 universities in ARWU 2013, were summarized in Table 8. For the 48 universities, the number of teaching staff ranged from a minimum of 300 to a maximum of 5,048, while the number of graduate students ranged from a minimum of 1,179 to a maximum of 16,516. The operational expenditures ranged from a minimum of 535 million USD in the University of California in Santa Barbara, to a maximum of 7,842 million USD in the University of Copenhagen. Among the output variables, the indicators of Alumni and Awards recorded the lowest averages and medians, which revealed the relative phenomena of 'the rich get richer and the poor get poorer'. Standard deviation of the 'PUB' (=number of papers published and listed in SCI or SSCI) marked the smallest value of 10.93, but the average had the largest value at 59.21, which demonstrated that the number of published papers from the top 100 universities was generally high.

Table 8: Descriptive statistics of input & output variables (unit: people, 1000 USD, published papers)

		Average	Standard Deviation	Minimum	Median	Maximum
Input Variables	Number of Teaching staff	2,478	1,267	300	2,211	5,048
Input Variables	Number of Graduate School Students	8,323	3,735	1,179	7,734	16,516
Input Variables	Operational Budget	2,906,058	1,667,587	535,458	2,487,950	7,841,733
Output Variables	Alumni	30.17	21.33	0	25.3	100
Output Variables	Awards	36.63	25.91	0	31.8	100
Output Variables	Hici	46.74	15.38	24	44.5	100
Output Variables	N&S	41.85	15.81	18.1	40.05	100
Output Variables	PUB	59.21	10.93	34	59.05	100
Output Variables	PCP	34.30	15.77	18	27.85	100

4.2. Results of comparison between AP efficiencies and ratings for Academic Ranking of World Universities

Relative efficiencies obtained from the super-efficiency AP model, which ranked the efficiency of DMUs in the DEA, are summarized in Table 9.

Five universities among the 48 subject universities received 100% efficiency, while the remaining 43 appeared to be relatively inefficient DMUs. Among the inefficient DMUs, 18 demonstrated efficiency ranging from 20% to 50%, while 19 demonstrated efficiency ranging from 50% to 80%.Only 6 DMUs demonstrated efficiency ranging from 80% to 100%. The most efficient university was Caltech, for which the super-efficiency was 446.87%. Next was the Karolinska Institute with a value of 177%,followed by UC Santa Barbara, Princeton, and Berkeley in that order. However, the Karolinska Institute and UC Santa Barbara were only assigned ranks of 44 and 35 by ARWU, which is contrary to the result indicated by application of the AP model which yielded the higher ranks of 2 and 3.Correlation between the ranks in ARWU and DEA/AP appeared to be very low (Pearson's correlation coefficient = 0.258). However, the correlation coefficient between the ranks generated from the DEA/AP model and PCP (Per Capita Performance) was 0.571, where the correlation of over 50% suggested that the DEA/AP model could be applied to the rating of relative efficiency of each DMU (University).

Table 9: Comparison of ARWU and super-efficiency rankings generated by AP model

Unit	ARWU		DEA/AP	
Unit	Ranking	PCP	Ranking	AP
California Institute of Technology	6	1	1	446.80%
Karolinska Institute	44	15	2	177.00%
University of California, Santabarbara	35	13	3	174.20%
Princeton University	7	3	4	169.10%
University of California, Berkeley	3	5	5	116.10%
University of Cambridge	5	6	6	94.00%
University of Oxford	10	9	7	91.60%
McGill University	58	32	8	87.50%
Massachusetts Institute of Technology	4	4	9	85.60%
The Johns Hopkins University	17	26	10	84.60%
Carnegie Mellon University	52	19	11	83.30%
Harvard University	1	2	12	77.10%
University of Minnesota, Twin Cities	29	34	13	77.00%
University of Zurich	60	37	14	75.50%
University College London (UCL)	21	21	15	73.60%
The University of Edinburgh	51	36	16	72.40%
University of California, San Francisco	18	18	17	72.00%
Columbia University	8	20	18	63.60%
University of California, San Diego	14	16	19	61.60%
Stanford University	2	7	20	59.00%
Yale University	11	14	21	58.40%
Swiss Federal Institute of Technology Zurich	20	8	22	58.40%
University of California, Irvine	45	29	23	58.30%
Washington in st.Louis	32	39	24	56.20%
The University of Tokyo	21	25	25	55.30%
University of British Columbia	40	41	26	52.50%
University of California, Davis	47	33	27	52.40%
University of Pittsburgh	61	48	28	51.70%
University of Toronto	28	27	29	50.60%
University of Chicago	9	10	30	50.30%
University of Melbourne	54	30	31	49.30%
Northwestern University	30	28	32	48.40%
Pennsylvania University Park	54	11	33	48.30%
Cornell University	13	12	34	47.80%
Vanderbilt University	49	47	35	47.20%
University of Maryland, College park	38	35	31	45.90%
University of Wisconsin-Madison	19	38	37	45.00%
Duke University	31	43	38	42.50%
New York University (NYU)	27	42	39	40.40%
University of Washington	16	24	40	39.20%
Purdue University - West Lafayet	57	45	41	35.40%

4.3. Potential values of elements in inefficient universities

The purpose of measuring the relative efficiencies was to provide effective input to universities for decision making, by identifying the level of resource inputs and corresponding outputs, thus the slack values (Target-Actual/Actual×100) in the DEA model were identified and summarized extensively in Table 10.

By reviewing the slack variables in representatively inefficient universities, it appeared that the University of Copenhagen, number 42 on the list, should reduce the number of teaching staff and operational expenditures by 79.4%. In this case, the output made from the input of the faculty, consisting of over 2,441 teaching staff, and the operational expenditures of over 7,800 million USD was too small. In the case of Johns Hopkins University, presented as number 17, the model also suggested that the university should reduce the number of graduate students by 80.9%, because the research productivity resulting from their 16,516 graduate students was too insignificant. As another example, the output of ‘Alumni’ for the University of California San Francisco, number 18 on the list, resulted from the fact that no alumni were awarded the Nobel or the Fields Medal prizes. This was similar in the case of number 61, in which the output of ‘Awards’ for the University of Pittsburgh also resulted from the fact that none of the teaching staff were awarded the Nobel or the Fields Medal prizes.

Table 10: Potential indicator values (slack values) of inefficient universities

Unit	Efficiency	Input Indicators			Output Indicators					
Unit	Efficiency	Teach. Staff	Graduate School	Operational Budget	Alumni	Award	HiCi	N&S	PUB	PCP
1	77.1	-22.9	-62.7	-22.9	0	58.8	23.5	0	0	109.2
10	91.55	-56.4	-8.4	-8.4	0	56.5	64.1	23.3	0	77.4
11	58.43	-41.6	-41.8	-41.6	0	84.5	24.8	0	0	137.9
12	34.96	-65	-65	-65	67.2	59.6	34.7	30.4	0	214.7
13	47.84	-52.2	-52.2	-52.2	0	16.2	3.3	6.7	0	93.5
14	61.57	-50.6	-38.4	-38.4	129.5	111.9	24	23.6	0	183.2
15	32.37	-71.9	-67.6	-67.6	35.4	124.8	34.1	45.6	0	162.5
16	39.24	-63.6	-60.8	-60.8	73.6	130.6	45	24.7	0	214.2
17	84.56	-15.4	-80.9	-46.6	85.1	201.7	107	89.9	0	455.5
18	71.96	-71.5	-28	-28	529482.9	98.2	35.3	34.7	0	231
19	45	-55	-56.1	-55	0	45	7.1	0	0	126.5
2	59.04	-41	-49.1	-41	81.7	37.9	0	0	16.1	110.6
20	58.39	-66.6	-41.6	-41.6	0	71.1	72.1	0	1.4	29.5
21	55.28	-44.7	-63.4	-44.7	8.2	311.5	57.9	0	0	152.6
21	73.6	-54.7	-27.2	-26.4	0	109.5	84.3	28.9	0	101.6
25	30.61	-69.4	-69.4	-69.4	13.3	36.3	16.9	20.8	0	140.1
27	40.43	-59.6	-75.7	-59.6	0	59	30.4	0	0	147.4
28	50.56	-49.4	-57	-49.4	68	189.8	55.3	7.2	0	124.2
29	77	-36.5	-59.6	-23	0	259.9	36.2	48.4	0	136.3
30	48.37	-51.6	-51.6	-51.6	50.9	110.1	15	2.2	0	92.4
31	42.46	-57.5	-57.5	-57.5	179	345	40.6	39.2	0	306.8
32	56.18	-61.2	-43.8	-43.8	51.9	119.2	51.6	11	0	168.3
36	24.1	-75.9	-75.9	-75.9	131.6	244.9	21.1	43.9	0	207.7
38	45.94	-69	-54.1	-54.1	8.8	142.5	38.7	35.6	0	100.4
4	85.64	-14.4	-58.9	-14.4	0	30.3	18.4	3.8	0	72.1
40	52.5	-47.5	-47.5	-47.5	73.8	209.7	111.7	61.6	0	185.2
41	33.28	-66.7	-66.7	-66.7	117.7	88.3	116.7	112.1	0	250.4
42	20.6	-79.4	-79.4	-79.4	70.2	241.1	157.1	91	0	138.7
45	58.25	-41.7	-41.7	-41.7	302214.8	57.9	29.2	33.9	0	128
47	24.64	-75.4	-75.8	-75.4	219871.2	38.4	13.1	23.8	0	125.2
47	52.41	-47.6	-47.6	-47.6	403154.4	567110.2	19.4	48.4	0	205
49	47.17	-77.2	-52.8	-52.8	137.9	112.2	86.2	167.2	0	350.9
5	93.97	-49.2	-6	-6	0	28.1	65.8	31.3	3.8	73.2
51	72.43	-54.1	-27.6	-27.6	0	259.3	106.6	21.6	0	97.8
52	83.26	-16.7	-20.8	-16.7	0	39.5	19	73.5	0	0.4
54	49.34	-51.8	-50.7	-50.7	40.2	325.3	183.9	104.3	0	123.9
54	48.3	-51.7	-51.7	-51.7	222.7	571987.3	23.3	63.1	0	241.9
57	35.42	-69.8	-64.6	-64.6	157.7	157.4	102.8	102.3	0	266
58	87.52	-12.5	-25	-12.5	0	485975.3	72.3	58.2	0	91
60	75.45	-24.5	-36	-24.5	423.1	41.2	46.5	0	0	85.2
61	51.69	-65.6	-48.3	-48.3	35.8	572398.3	58.4	130.7	0	249.5

In the case of number 54, the University of Melbourne, the output of ‘HiCi’, which implies the number of highly cited researchers, should be raised by 183.9% from the current point of 46.5.Similarly, number 49, Vanderbilt University, should raise the output of ‘N&S’, which implies the number of papers published in the journals Science and Nature, should be raised by more than 167.2% from the current point of 26. Finally, regarding the output of ‘PUB’, which implies the number of papers published and listed in SCI (E) or SSCI, the model indicated that number 2, Stanford University, should increase the production of published papers by 16.1% above the current level.

4 CONCLUSIONS

Changes in the national policy of education in each country have also resulted in changes in the paradigm of the market of higher education, creating a competitive market oriented to consumers of higher education. With the trend of globalization, the academic ranking of the world universities also has a great influence on the policies of higher education in each country. In this study, the ARWU, originating from Shanghai Jiao Tong University, was empirically examined to find potential problems in the rating system for the rankings of educational institutions, and to provide corresponding approaches to compensate for the identified problems. The ARWU results for the past 3 years (2011~2013) and related ratings were examined by region and by country to identify correlations between the rankings and the corresponding indicators. Further, the DEA/AP model, which analyzes super-efficiency, was applied to measure the relative efficiency of each DMU, and to compile a list of rankings for comparative analyses between universities. The results of the study were summarized as follows:

- In the Academic Ranking of World Universities (ARWU), the top 20 universities in the past 3 years all belonged to Europe (mostly the UK) and the United States of America, except for the inclusion of Tokyo University in Japan in the year 2012.In addition, over 80% of the top 100 ~ top 500 universities were occupied those in America and Europe. Universities in the rest of the world (Asia/Oceania/Africa) occupied only around 20%.
- Forty-three countries were among the top 500 in ARWU,while only 16 had universities belonging to the top 100. Twenty-five countries had universities included in the top 200, while it was 30 and 36 countries had universities in the top 300 and top 400, respectively.
- Correlation between ARWU and the corresponding indicators was examined, and ‘N&S’ appeared to be the most influential for determining the rankings of universities. That is, the relative dominance in the number of papers published in the journals ‘Science’ and ‘Nature’ showed a high relevance with the higher rankings of the universities, where the interrelationship between rankings over the past 3 years and the indicators appeared in the following order: N&S>HiCi>Awards>Alumni>PCP>PUB. The indicator ‘PUB’ (number of papers published and listed in SCI and SSCI) showed the smallest standard deviation of 10.93 with the highest average value of 59.21, which suggested that the range of variation in rankings between universities due to this indicator was insignificant. The ‘Awards’ category, which was the indicator representing the number of alumni (professors) awarded the Nobel or the Fields Medal prizes, seemed to be relatively influential upon the ranking of universities, but appeared to have a lower correlation with the ranking.
- Results of the analysis of the top 100 universities showed that only two universities ranked in the top 100 were without alumni (or professors) awarded the Nobel or the Fields Medal prizes. These included California Davis (top 40) and Texas A&M (top 90).Thus, it was

estimated that this condition may be essential for universities to be included in the top 100 of ARWU.

- Forty-eight of the educational institutions in the top 100 of ARWU were examined through the DEA/AP model, and the results of this examination indicated that only 5 universities were 100% efficient, while the remaining 43 appeared to be relatively inefficient. The numbers and respective measured efficiencies were as follows: 18 DMUs with efficiencies ranging from 20% to 50%, 19 DMUs with efficiencies ranging from 50% to 80%, and 6 DMUs with efficiencies ranging from 80% to 100%.

Caltech appeared to be the most efficient university, indicated by its high super-efficiency value of 446.78%. The Karolinska Institute was ranked next with a super-efficiency of 177%, followed in order by UC Santa Barbara, Princeton, and Berkeley. The number of teaching staff in the 48 universities ranged from a minimum of 300 to a maximum of 5,048, while the number of graduate students varied from a minimum of 1,179 to a maximum of 16,516. In the case of operational expenditures, the values varied from about 500 million USD to over 7,800 million USD, which revealed quite a large gap between the scales of economy. Correlation between the ranks in ARWU and those calculated by DEA/AP appeared to be very low (Pearson's correlation coefficient = 0.258).However, the correlation coefficient between the ranks generated from the DEA/AP model and PCP (Per Capita Performance) was 0.571, where the correlation of over 50% suggested that the DEA/AP model fitted for the assessment of relative efficiencies among DMUs could also be applied for rating of rankings of world universities. That is, the applicability of the DEA/AP model might be improved if the common variables correlated with inputs and outputs were found and exploited to measure the efficiencies of DMUs (universities).

It seems that the ARWU was made to be advantageous to educational institutions placed in Europe or America, with indicators referring to information dated back as far as the 1920s, such as the 'Awards' referring to the number of alumni or faculty who had been awarded the Nobel or the Fields Medal prizes. Referring to such indicators could lateralize the way of rating. Thus, further consideration to improve or modify the current system of ARWU may be needed voluntarily by Shanghai Jiao Tong University. As an alternative, the DEA/AP model fitted for the relative assessment of DMUs could also be employed, or added to the current system of ARWU assessment.

Universities in the world are now experiencing a borderless environment. The strong wave of globalization demands innovation and changes of the universities in the world. Universities unable to cope with such trends might be weeded out. In spite of the existence of some considerations which need to be made regarding the ranking of educational institutions in the world, the ARWU is still a necessary indicator for universities who wish to grow further, and will remain as a good guideline. Universities in the world should find ways to exploit such indicators to secure engines or mechanisms to be the First Mover.

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