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What contributes more to the ranking of higher education institutions? A comparison of three world university rankings

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Recently, many universities have drawn attention to world university rankings, which reflect the international competition of universities and represent their relative statuses. This study does not radically contradict types of global university rankings but calls for an examination of the effects of their indicators on the final ranking of universities. By using regression analysis, this study investigates the indicator contribution to the ranking of universities in world university ranking systems, including the Academic Ranking of World Universities (ARWU), Times Higher Education (THE), and QS World University Rankings. Results show that in the ARWU system, three indicators regarding faculty members who won Nobel Prizes and Fields Medals and papers published in Nature and Science and in the Science Citation Index and Social Science Citation Index journals predicted the ranking of universities. For the QS and THE systems, the more powerful contributors to the ranking of universities were expert-based reputation indicators.

Keywords: world university rankings; ranking indicators; indicator contribution; ranking of universities; university position

INTRODUCTION

Driven by globalization and massification in higher education (Altbach, 2012), university rankings and league tables are having an ever greater impact on higher education institutions (HEIs). Similar to the pursuit of accountability and objective evaluation, university rankings exist ubiquitously (Wildavsky, 2010). Both national and international university rankings are growing explosively and becoming more specialized by, for example, focusing on research performance or institutional reputation (see Rauhvargers, 2011; Shin & Toutkoushian, 2011). In particular, world university rankings, which are our concern in this paper, are considered by many to be a means of representing academic excellence and increasing prominence of HEIs in both local and global contexts.

Improving global rankings [1] in league tables is often a priority goal for many universities. World university rankings serve as a reference point for student choices for universities and scholar mobility across the globe, provide a guide to public policies, help in decision-making by funding agencies and university leaders, and even play a role in positioning and measuring the performance of higher education institutions in the domestic and global contexts (Altbach, 2006, 2012; Bastedo & Bowman, 2011; Hazelkorn, 2009, 2014; Huisman & Currie, 2004; Marginson & van der Wende, 2007; Salmi & Saroyan, 2007; Williams, 2008). In light of the positive relationship between Web links and ranking orders found by Lee and Park (2012), universities themselves endeavour to participate in global ranking activities and pursue higher ranks to obtain greater visibility and resources from multiple stakeholders (Hazelkorn, 2014). Thus, global rankings are often regarded as "a mechanism of agenda setting" with soft power (Lo, 2011, p. 216) and "an integral part of [the] status culture" of higher education competition (Marginson, 2014, p. 45). The higher the ranking, the more visibility and opportunities HEIs generally gain within their respective countries and across the globe.

World university rankings are an attractive and often competitive measurement of institutional performance by bibliometric methods (van Raan, 2005). To some extent, global rankings value stakeholder choices and investments, set institutional benchmarks, reorganize higher education institutions that work ineffectively, determine institutional priorities, and boost faculty academic professional reputation (Hazelkorn, 2009; Shin & Toutkoushian, 2011). An empirical study conducted by Bastedo and Bowman (2011) links college rankings with an institutional ability to gain greater financial resources. In terms of student recruitment, global rankings play an important role in student preferences and choice. A report initiated by the QS Intelligence Unit (2015) notes that over 70% of surveyed students consider global rankings more important in their university selection process than national or regional rankings, making them a crucial factor in the institutional selection for many students (Roberts & Thomson, 2007) because students tend to relate higher ranked institutions with better reputation and academic excellence.

World university rankings also influence strategic direction and decisions made by senior higher education administrators, including in how they react among and between leaders of other HEIs (Hazelkorn, 2009). Higher ranked universities are like institutional sponges that generally have greater opportunities to gain sustained public funding and private investments. Institutional reputation linked to global rankings also makes it easier for the top-ranked HEIs to attract scholars and students from domestic and international locations. World university rankings serve as an important underpinning of institutional reputation (Bowman & Bastedo, 2011) and in providing greater perceived "credibility" (Vieira & Lima, 2015, p.63). Rankings are also influential in producing a non-negligible effect on graduates' wages (Carroll, 2014). Many HEIs strive to align strategic plans and institutional performance to the criteria of world university rankings to solidify and boost their ranking position among the top institutions.

However, world university rankings have raised controversy, including their neglect of audiences' needs, the preference for English-language publications as a key indicator, an overemphasis on the fields of science and medicine, subjectivity of survey indicators, arbitrary weighting, the variability of ranking results, and the bias between

[1] In this article, the term *global rankings* refers to world university rankings produced on an annual basis by several leading ranking systems.

ordinal/numeric representation and the actual quality of university education (Bastedo & Bowman, 2011; Dill & Soo, 2005; Fidler & Parsons, 2008; Frey & Rost, 2010; Marginson, 2014; Proulx, 2007; Saisana, d'Hombres, & Saltelli, 2011; Taylor & Braddock, 2007; Tofallis, 2012; van Vught & Westerheijden, 2010; Williams, 2008). Furthermore, an overemphasis on world university rankings is like jumping into a risky venture; for instance, rather than focusing their decision on which institution to attend based on outstanding academic performance, students often make their choice on institutional reputation (Taylor & Braddock, 2007).

Another common indicator critique of world university rankings is the preference for research publications from the Science Citation Index (SCI) and the Social Science Citation Index (SSCI). SCI and SSCI are widely recognized in academic circles for defining success, boosting institutional reputation, and justifying university rankings. But overvaluing the SCI and SSCI indicator may give rise to what Su (2014, p. 51) calls an "I-idolization" or an overemphasis on the leading publication indices. Other scholars list several shortcomings that relate to academic recognition, the marginalization of the humanities and social sciences, and institutional image (Deem, Mok, & Lucas, 2008; Delgado & Weidman, 2012).

There is also an invisible pressure in the pursuit of increasing institutional reputation that often intensifies the competition between HEIs and between countries. Moreover, Proulx (2007) argued that ranking results based primarily on SCI and SSCI research outputs are likely to persuade many leaders of ranked universities to over-emphasize the need for greater research publication outputs rather than focusing on developing relevant strategies to become world-class universities. Thus, world university rankings often lead to in an inherent risk of competition that ultimately excludes many of flagship universities (Amsler & Bolsmann, 2012; Douglas, 2016); HEIs compete internationally for human and financial resources, and their competitive institutional behaviours are simultaneously reinforced by the global ranking results (van Vught & Westerheijden, 2010).

Although many studies have documented various issues surrounding global university rankings, few studies have demonstrated the relationship between the indicators used and the ranking of universities in a particular ranking system; that is, which indicators have a greater impact on determining the ranking of universities. Understanding the contribution of indicators of global rankings is fundamental to understanding the role of global rankings and their methodologies as well as HEIs' strategies for pursuing global rankings.

This paper reports on a study investigating indicator contributions to the ranking of institutions of three of the most prominent world university ranking systems: the Academic Ranking of World Universities (hereafter referred to as ARWU) developed by Shanghai Jiao Tong University in China; the *Times Higher Education* World University Rankings (hereafter referred to as *THE*) created by Thomson Reuters; and Quacquarelli Symonds' World University Ranking (hereafter referred to as QS). In other words, our study sought to explore whether the weights of the indicators in these three global ranking systems are different to the assigned weights shown in their methodologies, and whether some indicators matter more than others. In this study, we first describe the characteristics and methodologies of the three ranking systems and common criticisms regarding their indicators. We then analyse the indicators' contribution to the ranking of HEIs to better understand the implications global university rankings have in practice.

THREE WORLD UNIVERSITY RANKING SYSTEMS: FEATURES AND CRITICISM

The ARWU, *THE*, and QS rankings are the "big three," according to Hazelkorn (2014, p. 17), being among the most frequently used by scholars, administrators, policy makers, and students. The first global ranking system developed was the ARWU in 2003. The next year, *Times Higher Education* and the Quacquarelli Symonds Company co-published their own ranking systems, which is usually referred to as *THE*-QS (Liu & Cheng, 2011). However, in 2010, *THE*, and QS ended their collaboration and separated into two separate ranking systems.

Features of the selected ranking systems

Table 1 shows the background of these three systems.

Table 1: Main characteristics of the three university ranking systems

	Academic Ranking of World Universities (ARWU)	**QS World University Ranking**	***Times Higher Education* World University Ranking (*THE*)**
Background			
Issued by	Academic institution (Shanghai Jiao Tong University)	Media (Quacquarelli Symonds)	Media (Thomson Reuters)
Years	11 (since 2003)	Since 2004, *THE* cooperated with QS. However, *THE* decided to change the partner and developed its own methodology in 2010	
Target audience	No	No	No
Methodology			
Criteria/Dimensions	4	0	5
Number of indicators	6	6	13
Conducting reputation survey	No	Yes	Yes
Data sources	Thomson Reuters' Web of Science Database, Resources of National agencies	Scopus Database, University portfolio, Survey	Thomson Reuters' Web of Science Database, University portfolio, Survey
Results published on the web	Yes	Yes	Yes
Ordinal Results	Top 500 (Single ranks to 100 and then groups)	Top 700 (Single ranks to 400 and then groups as 401–410, 411–420, 421–430, 431–440, 441–450, 451–460, 461–470, 471–480, 481–490, 491–500, 501–550, 551–600, 601–650, 651–700)	Top 400 (Single ranks to 200 and then groups as 201–225, 226–250, 251–275, 276–300, 301–350, 351–400)

Source: Authors.

ARWU is created by an academic institution (Shanghai Jiao Tong University), while the other two are developed by the mass media. All the selected ranking systems focus on the evaluation of research-led universities worldwide, even though their methodologies are not similar.

Rather than the specific target groups, all individuals and stakeholders engaged in higher education are the intended audience. These global rankings are likely to influence and drive the perceptions and behaviours of individuals and organizations, such as students, parents, faculty, and staff members, public authorities, and employers and community members (Thakur, 2007; van Vught & Westerheijden, 2010).

Except for surveys and resources from national agencies and university profiles, all the selected ranking systems use databases to analyse research publications and citations through a bibliometric method. QS uses the Scopus database, and the other two collect information from Thomson Reuters' Web of Science database. The ARWU system also collects data from select websites (e.g., SCI, SSCI, Nobel laureates, and Fields Medals), and *THE* and QS also conduct reputation surveys.

The three ranking systems commonly publish their results online using ordinal rankings in lists. ARWU publishes a list with the top ranked 500 institutions in which universities are ranked from one to 100 and then grouped as 101–150, 151–200, 201–300, 301–400, and 401–500. The QS system uses the methodological framework that served as the original version of the *THE*-QS rankings (Quacquarelli Symonds, 2014) and publishes a list of the top 700 universities online, of which the top 400 institutions are singly ranked and the latter 300 are grouped. *THE* releases an online league table of the top 400 universities, which are singly ranked up to 200 and then grouped as 201–225, 226–250, 251–275, 276–300, 301–350, and 351–400. The ARWU system has better ordinal proportionality than the QS and *THE* systems (Marginson, 2014) because of its fixed proportion of ordinal results.

Evaluative standards of the selected ranking systems

Each system uses its own standards for evaluation and weighting. In 2011, *THE* ended its collaboration with QS and developed a new methodology with a different partner—Thomson Reuters. Instead of the old six indicators that QS still uses, the new *THE* methodology consists of 13 indicators ranging from teaching and research to knowledge transfer (Thomson Reuters, 2010). Table 2 illustrates the indicators and their assigned weights in these ranking systems.

The ARWU ranking system includes six indicators among four dimensions (Shanghai Jiao Tong University, 2014). First, the dimension of education quality is determined by one indicator—the number of alumni who have won Nobel Prizes and Fields Medals (coded as Alumni), and this indicator contributes 10% to the overall score. Second, the dimension of faculty quality is evaluated by two indicators; one is related to Nobel Prizes and Fields Medals granted to faculty members (coded as Award), and the other is HiCi, a parameter related to highly cited researchers in 21 subject categories. These two indicators account for 20% each. Third, the research output dimension is also determined through two indicators: papers published in *Nature* and *Science* (coded as NS) and those indexed in SCI and SSCI (coded as PUB). These two indicators account for 20% each. Finally, the per capita performance of an institution (abbreviated to PCP) contributes 10% to the overall score.

Table 2: Indicators and assigned weights of selected university ranking systems

Title	ARWU	QS	*THE*
Dimension/ Indicator	◆Quality of Education - Alumni (10%) ◆Quality of Faculty - Award (20%) - HiCi (20%) ◆Research Output - *Nature* and *Science* (20%) - PUB: SCI & SSCI (20%) ◆Per Capita Performance (10%)	◆Academic reputation (40%) ◆Employer survey (10%) ◆Citation per faculty (20%) ◆Faculty-student ratio (20%) ◆International students (5%) ◆International faculty (5%)	◆Teaching (30%) - Reputation survey for teaching (15%) - Staff-student ratio (4.5%) - Doctoral-bachelor's ratio (2.25%) - PhDs awarded (6%) - Institutional income per faculty member (2.25%) ◆Research (30%) - Reputation survey for research (18%) - Research grants (6%) - Papers in peer-reviewed journals (6%) ◆Citation impact (30%) ◆Industry income (2.5%) ◆International outlook (7.5%) - Ratio of international-domestic students (2.5%) - Ratio of international-domestic staff (2.5%) - Publication with international co-authors (2.5%)

Source: Created by the authors with criteria from Quacquarelli Symonds (2014), Shanghai Jiao Tong University (2014), and Thomson Reuters (2014).

The *THE* system uses 13 indicators for five dimensions (Thomson Reuters, 2014). First, the teaching dimension is assigned a weight of 30% and is determined through five indicators, teaching reputation survey, staff-to-student ratio, doctorate-to-bachelor ratio, doctorate awards by an institution, and institutional income scaled against academic staff numbers. Second, the research dimension has a 30% share and is established through research reputation survey, research grants, and the number of papers published in academic journals. The third dimension is citation impact, given a weight of 30%. The fourth dimension is research funding from industry, contributing 2.5% to the overall score. Finally, the international outlook dimension of an institution is assigned a weight of 7.5% and is determined through the international-to-domestic student ratio, international-to-domestic staff ratio, and number of internationally co-authored research papers.

The QS ranking system still uses the original methodological framework (Quacquarelli Symonds, 2014). Among the six indicators included in the QS system, the most important is the academic peer reputation survey, with a weight of 40%. Another reputation survey addresses employers and contributes 10% to the ranking. Then, the two indicators of citations per faculty and faculty-student ratio contribute 20% each to

the overall score. Finally, the numbers of international students and faculty indicators have a weight of 5% each.

It is important to note the similarities in these ranking systems; the differences lie in the weights of the indicators used. University rankings, according to Proulx (2007), should represent the characteristics of the ranked universities and "avoid a one-size-fits-all typology" (p. 76). All the indicators of these ranking systems are grouped into five categories, including teaching, research, service mission, reputation management, and internationalization of higher education institutions (Table 3). These five categories result from several multifaceted and interactive factors. In particular, the last two categories seem to be relevant in the context of knowledge-based economic societies. However, the weights assigned to the indicators seem to reflect the emphasis of each global ranking system and have some biases. For instance, the ARWU system focuses on research and eliminates teaching, service mission, and internationalization; and the indicators of the QS and *THE* systems are incomplete in assessing the effectiveness of teaching and learning and research funding (Marginson, 2014), though both have some measures for these five categories.

As shown in Table 3, the ARWU system emphasizes research excellence, while the QS system focuses more on universities' reputation (Aguillo, Bar-Ilan, Levene, & Ortega, 2010; Huang, 2011). For instance, the ARWU system assigns a weighting of approximately 90% to impressive research performance, such as Nobel Prizes and Fields Medals granted to alumni and faculty members and publication in famous English-language journals. By contrast, the QS system depends greatly on university reputation, representing nearly 50% of the total score.

Table 3: Priorities of selected university ranking systems

Title / Category	ARWU	QS	*THE*
Teaching		✓	✓
Research	✓(*)	✓	✓(*)
Service		✓	✓
Reputation	✓	✓(*)	✓
Internalization		✓	✓

Note: * refers to the category given the most assigned weights in the system.
Source: Authors.

In addition, the dimensions evaluated by the QS and *THE* ranking systems are similar, but the indicators of the *THE* system are more detailed and complex (Marginson, 2014). In the *THE* system, more than one-third of the overall score is associated with research outcomes such as research grants, publications, and citations. However, in the QS system, less than one-fourth of the total weight is allocated to research outcomes. Even though both of these two ranking systems measure university reputation, the *THE* system assigns approximately 33% to reputation surveys, while, in the QS system, it accounts for 50% of the overall score. Both ranking systems give approximately 10% to the internationalization of higher education institutions and have some indicators to assess the teaching mission, but the QS system employs only one indicator of it, the faculty/student ratio.

Criteria debate of the selected ranking systems

As already noted, the three ranking systems have been extensively criticized (see Marginson, 2014; Taylor & Braddock, 2007). The incomplete databases used by the three ranking systems tend to have biases against the non-English-language publications and the fields of social science and humanities (Amsler & Bolsmann, 2012; van Raan, 2005). The biases in favour of hard-science and English-language publications also result from the different publication cultures and citation habits in diverse fields (Frey & Rost, 2010; Saisana et al., 2011; van Vught & Westerheijden, 2010).

Another similar criticism of the three ranking systems is the challenge concerning their selections of indicators and arbitrary weighting. The numeric, comparable, and standardized league tables produced by global university rankings often lead the uninformed public to believe the truth of the information. Through league tables, everyone can easily interpret and compare the quality of certain universities. Those who publish rankings also believe that the ranking results reflect the position and quality of a university through a rigorous and objective process of evaluation (Rauhvargers, 2011). However, as argued by Williams and Van Dyke (2008), "the objectivity does not ensure that the measures actually chosen are always appropriate" (p. 2). Taylor and Braddock (2007) argued that the weights of indicators depend on the significance of the set of indicators suggested by higher education consultants, and most ranking systems have chosen the "suitable" indicators instead of the negative ones, jeopardizing institutional or national interest (Marginson, 2014, p. 46). For instance, because of the initial purpose of understanding the global standing of top Chinese universities (Liu & Cheng, 2011), the ARWU system relies heavily on research performance without consideration for the teaching, social service, internationalization, and employability of university graduates (Marginson, 2014; Saisana et al., 2011).

In the ARWU ranking system, focusing on research-oriented indicators is frequently criticized. Aside from the biases in favour of hard-science and English-language journals, the Nobel indicator affects the lower-ranked universities located in countries with few Nobel Prize and Fields Medal winners, and underrepresents the diversity of academic fields and other scholars' achievements (Huang, 2011; Marginson, 2014).

For the QS and *THE* systems, the major criticism involves the subjectivity of reputation surveys, the teaching indicators, and the instability of the rankings. Employing expert-based reputation surveys as a ranking indicator is subjective to the bias caused by human opinions and judgments on a university (Salmi & Saroyan, 2007; Williams & Van Dyke, 2008). In other words, the subjectivity of survey indicators is inevitable in relatively objective ranking indicators (Dill & Soo, 2005; Taylor & Braddock, 2007). In terms of teaching criteria, Trigwell (2011) stated that, in the QS system, using a single indicator—staff-to-student ratio—to assess the teaching performance of a university is questionable; this indicator depends on class size but also cannot accurately reflect teaching quality and the diversity of teaching and learning activities. As with the QS system, it is difficult to evaluate actual teaching effectiveness even though the *THE* system adds other indicators to assess teaching performance, such as PhDs, the doctoral-bachelor's ratio, and the facilities and income of an institution. Then, the variability and fluctuation of the rankings result from the frequency of changes in methodology and the use of surveys in the QS and *THE* systems (Marginson, 2014; Saisana et al., 2011). The empirical study conducted by Aguillo et al. (2010) indicated that the dissimilarities between the *THE*-QS rankings for different years are high. In other words, the *THE* and QS systems are more unstable than the ARWU system.

Intuitively, all ranking systems have different impacts on ranking results, including the overall score and the ordinal ranking of universities because of their different frameworks of indicators. Investigating which indicators of the three world university rankings best predicts the ranking of universities would be interesting.

RESEARCH METHOD

Data sources

All data were obtained from the ARWU, *THE*, and QS world university rankings. As the source of data, we chose the top 100 universities from each selected ranking system in accordance with their 2013-14 world university rankings released on their websites. For each ranking system, the data we collected included the scores for every criterion and the overall scores, as well as the ranking of the 100 institutions. However, because Harvard University is the benchmark in the ARWU system, it was excluded from our data from the ARWU rankings.

Data analysis

We used secondary data and regression analysis in the study. We used regression analysis to explore the effects of independent variables on an outcome variable (Treiman, 2009). For each ranking system, we used bivariate regression to examine the effect of a single indicator on the ranking separately, and we employed multiple regression to investigate the impact resulting from the whole set of the indicators.

Limitations and contributions

The major limitation of this study is the change of ranked universities that are shown on the lists of the three world university rankings. In this study, we chose world university rankings in 2013-14 as our data set. We chose to study only the top 100 ranked institutions but those in the top 100 changed depending on the year, thus leading to a bias. However, the variation of ranked universities on the top 100 lists of these three global rankings is smaller than those on other ordinal categories. In order to eliminate biases resulted from the uncertainty and variation, we focused on the top 100 in the selected world university rankings.

However, two features of our study should be emphasized. First, although every ranked university *receives* an overall score and a respective ranking, this ordinal ranking is likely to represent the position of a university. Thus, in our study, we paid more attention to the ranking of universities than to the final scores these HEIs received. Second, we only selected the top 100 universities instead of all ranked schools shown in the rankings (e.g., the top 500 in the ARWU rankings) because these top 100 universities are given unique rankings. Moreover, receiving the first-tier rankings implies that these universities have more opportunities and better competitiveness than others in terms of marketing.

RESULTS AND COMPARISON

Overall, all Pearson correlation coefficients between the single indicator and the ranking of a university in each system were negative. The reason is that the increase of the numerical value refers to more attention on indicators but not on the higher ranking of

institutions. The smaller the value (such as Top1means) relates to institutions with the best performance. Rather than indicating the relative significance between positive and negative correlations, this shows that the indicators and the ranking of a university in each system move in the opposite way (Treiman, 2009). According to the results of our study, all correlation coefficients were statistically significant with respect to ranking of universities in the ARWU and QS ranking systems, while some were nil in the *THE* system. The following section describes the regression analysis of each selected ranking system in detail.

ARWU system

Table 4 shows the regression summary of the ARWU rankings. The final model (model 7) that includes the six indicators explained 83% of the variance in the ranking of universities ($F (6, 92) = 73.403$, $p < .001$). Even the adjusted R^2 also provided an explanation of 82%. As shown in Table 4, three indicators were significantly and inversely related to the ranking of universities, including Award ($b = -.542$, $p < .001$), NS ($b = -.770$, $p < .001$), and PUB ($b = -.728$, $p < .001$). By comparing their standardized weights (βeta-weights), we found that the Award indicator had the most substantial impact on the ranking of universities ($\beta = -.405$), more than the NS ($\beta = -.362$) and PUB ($\beta = -.294$) indicators.

Table 4: Regression analysis for the ARWU system

Model (with indicators)				R	R^2	Adjusted R^2
1 Alumni				.615	.378	.372
2 Award				.697	.486	.481
3 HiCi				.766	.587	.583
4 NS				.838	.702	.699
5 PUB				.590	.348	.341
6 PCP				.453	.205	.197
7 Alumni, Award, HiCi, NS, PUB, PCP				.910	.827	.816
	b-weight (βeta-weight)					
Indicator	Between each indicator and the rank					Final model
Alumni	-1.066*** (-.615)					-.066 (-.038)
Award		-.932*** (-.697)				-.542 (-.405)***
HiCi			-1.646*** (-.766)			-.200 (-.093)
NS				-1.783*** (-.838)		-.770 (-.362)***
PUB					-1.462*** (-.590)	-.728 (-.294)***
PCP						-1.091*** (-.453) .141 (.058)

Notes: (a) ***p ≤ .001, **p ≤ .01, *p ≤ .05. (b) Alumni = Alumni winning Nobel Prizes and Fields Medals; Award = Staff winning Nobel Prizes and Fields Medals; HiCi = Highly cited researchers; NS =Articles published in Nature and Science; PUB = Science Citation Index and Social Science Citation Index; PCP = Per capita academic performance.

Source: Authors.

Using bivariate regression, each indicator had statistical significance in explaining its effect on the ranking of universities. The top two contributors to institutional ranking were the NS and HiCi indicators (models 4 and 3), which could individually explain more than 50% of the variance in the ranking of universities, but unfortunately, the HiCi indicator was not statistically significant in the final model (model 7). The third most influential contributor to institutional ranking was the Award indicator, with an adjusted R^2 of 48%. In other words, 48% of the variation in the ranking of universities could be explained with Award. Then, the Alumni and PUB indicators separately explained approximately 35% of the variance in the ranking system, but the PUB indicator had statistical significance in the final model. Finally, the PCP indicator received an adjusted R^2 value lower than 20%; relatively, the PCP indicator contributed less to the ranking of universities.

THE ranking system

The overall model (model 6) that includes the five criteria explained 90% of the variance in the ranking of universities ($F (5, 85) = 164.782$, $p < .001$). As the results in Table 5 illustrate, three indicators—teaching ($b = -.697$, $p < .001$), research ($b = -.775$, $p < .001$), and citation ($b = -.490$, $p < .001$)—were significantly and inversely related to the ranking of universities and international outlook ($b = -.124$, $p < .05$), while the industry income criteria had no significance. In comparing their standardized weights (βeta-weights), we found that the research indicator had the most powerfully substantial impact on the ranking of universities ($\beta = -.506$), and the second one was teaching ($\beta = -.400$). Both of them were more than twice that of the citation indicator ($\beta = -.206$) and more than four times that of the international outlook indicator ($\beta = -.084$).

Table 5: Regression analysis for the *THE* system

Model (with indicators)					R	R^2	Adjusted R^2
1 Teaching					.904	.817	.815
2 Research					.902	.813	.811
3 Citation					.410	.168	.160
4 Int'l Outlook					.127	.016	.006
5 Industry					.113	.013	.002
6 Teaching, Research, Citation, Int'l Outlook, Industry					.952	.906	.901
	b-weight (βeta-weight)						
Indicator	Between each indicator and the rank						Final model
Teaching	-1.586*** (-.904)						-.697 (-.400)***
Research		-1.398*** (-.902)					-.775 (-.506)***
Citation			-.991*** (-.410)				-.490 (-.206)***
Int'l Outlook				-.193 (-.127)			-.124 (-.084)*
Industry					-.142 (-.113)		.014 (.011)

Notes: (a) ***p ≤ .001, **p ≤ .01, *p ≤ .05. (b) Int'l Outlook = International outlook; Industry = Industry income.

Source: Authors.

When analysing the relationship between single indicator and the ranking of universities, we found that three of five criteria had statistical significance in explaining their effect on the ranking except the international outlook and industry income criteria. The top two contributors to the ranking were teaching and research (models 1 and 2), which could individually explain approximately 80% of the variance in the ranking of universities. The third contributor to the ranking was the citation indicator, with an adjusted R^2 of 16%. The other two indicators had adjusted R^2 values lower than 1%. Interestingly, the international outlook indicator was statistically significant in the final model but not important when we assessed its single effect on the ranking.

QS Ranking System

The regression results for the QS ranking system are illustrated in Table 6.

Table 6: Regression analysis for the QS system

Model (with indicators)	R	R^2	Adjusted R^2
1 Peer	.746	.556	.552
2 Employer	.535	.286	.279
3 F/S ratio	.630	.396	.390
4 Int'l faculty	.205	.042	.032
5 Int'l student	.327	.107	.098
6 Citation	.336	.113	.104
7 Peer, Employer, F/S ratio, Int'l faculty, Int'l student, Citation	.985	.970	.968

	b-weight (βeta-weight)						
Indicator	Between each indicator and the rank						Final model
Peer	-2.035*** (-.746)						-1.456 (-.533)***
Employer		-.974*** (-.535)					-.255 (-.140)***
F/S ratio			-.751*** (-.630)				-.596 (-.500)***
Int'l faculty				-.192* (-.205)			-.101 (-.108)***
Int'l student					-.355*** (-.327)		-.161 (-.148)***
Citation						-.506*** (-.336)	-.499 (-.332)***

Notes: (a) ***p ≤ .001, **p ≤ .01, *p ≤ .05. (b) Peer = Academic reputation by peer review; Employer = Employer survey; F/S ratio = Faculty/Student ratio; Int'l faculty = Proportion of international faculty; Int'l student = Proportion of international student.

Source: Authors.

The final model (model 7) that includes the six indicators provided a very strong explanation of 97% for determining the ranking of universities ($F(6, 93) = 497.673$, $p < .001$). As shown in Table 6, all indicators were significantly and inversely related to the ranking of universities. By comparing their standardized weights (βeta-weights), we found that the top two indicators with the most substantial impact on the ranking of

universities were peer review (β = -.533) and faculty-student ratio (β = -.500). The third most influential contributor was the citation indicator (β = -.332). The influence of these three indicators was more than twice that of the other three indicators, including employer survey and the number of international students and faculty members.

According to the bivariate regression, each indicator had statistical significance in explaining its effect on the ranking. The most influential contributor to the ranking was peer review (model 1), which could explain 55% of the variance in the ranking of universities. The next most influential contributor to the ranking was the faculty-to-student ratio, which could explain 39% of the variation in the ranking of universities. The third one was the employer survey indicator, with an adjusted R^2 of 28%. In other words, 28% of the variation in the ranking of universities could be explained by the employer survey. The other three indicators had adjusted R^2 values equal to or less than 10%.

Most indicators of these three ranking systems made substantial contributions to the ranking of the top universities except two indicators of the *THE* system: international outlook and industry income. In the ARWU system, three indicators: Award, NS, and PUB, had statistical significance in predicting the ranking of universities. Even though the variance in the ranking of universities could be explained with HiCi (adjusted R^2 of 58%), it was not statistically significant. That is to say, the ARWU ordinal ranking could be determined by Award, NS, and PUB. In terms of the QS and *THE* systems, the more powerful contributors to the ranking of universities were expert-based reputation indicators, including the peer review of the QS system and the teaching and research criteria of the *THE* system. These findings were consistent with the results of several previous studies (e.g., Huang, 2011; Marginson, 2014; Saisana et al., 2011). This seemed to imply that universities have opportunities to receive higher rankings if they have *tangible, popular*, and *customer-appreciated* research products and an *excellent* reputation.

The regression analysis of these three ranking systems suggest that not all indicators in each ranking system contribute equally to the prediction of their final ranking of universities. In other words, several indicators could explain their respective rankings, while some indicators might not make an authentic contribution of the ranking prediction. Moreover, the importance of the most influential indicators to the final ranking of universities could be dissimilar to their assigned weights in the methodologies. For instance, according to the ARWU methodology, the NS indicator is assigned a weight of 20%, but this single indicator can explain approximately 70% of the variance in the ARWU ranking of universities. Although the final ranking of universities results from multiple factors and are influenced by them, the effect of a single indicator on the final ranking results cannot be neglected.

CONCLUSION

Facing increasing competition between HEIs in domestic and global contexts, the number of ranking systems at the national and international levels is increasing. University rankings are seen as a meaningful representation of bettering academic excellence and institutional reputation. In order to achieve these goals, most HEIs make a concerted effort to participate in institutional ranking activities rather than escape from them. In particular, world university rankings have gradually drawn greater attention in international and comparative higher education. The basic goal of global university

rankings is to provide information to inform student choices of universities, but the impact and use of global rankings have changed. Global university rankings serve as tools for evaluating universities' outstanding performance as well as marketing and positioning within countries and around the world. They become politically exclusionary instruments (Amsler & Bolsmann, 2012) and a tool of status control (Marginson, 2014). In other words, the ordinal numbers shown in the global rankings implies the position and competitiveness of a university. Thus, in the current study, our intention is not to deny global university rankings but to argue that international ranking systems should be carefully examined and that their results should be deliberately interpreted.

The selected global ranking systems are not perfect in measuring higher education institutional performance and in awarding their ordinal statuses across the globe. After analysing the contributions of the indicators to the final ranking of universities in the three ranking systems, we obtained several findings. First, most indicators of the three ranking systems were positively correlated with their overall ranking except the international outlook and industry income indicators of the *THE* ranking system. The reason that these indicators were not statistically significant might involve their lower assigned weights and whether universities were willing to provide accurate information on financing and internationalization. Thus, we highlight the need for HEIs and those who publish the rankings to be aware of and sensitive to the methodological issues and the transparency of institutional financial and internationalization data.

We also note that, in the three ranking systems, not all indicators contribute to the ranking of universities. This seems to imply that the ranking of HEIs might be determined by a few indicators. The various methodologies of different ranking systems may cause vulnerabilities in the seemingly objective evaluations and redundant evaluative criteria. However, as stated by Rauhvargers (2011), readers seldom receive and understand the actual information regarding the calculation to obtain the final ranking. Unfortunately, too often readers might be misinformed. The audience might also overestimate or underestimate the contributions of some indicators to the final ranking. Hence, we caution higher education stakeholders at all levels against using and interpreting the surface ordinal numbers and about making public decisions based solely on global ranking systems. We also suggest that the indicators chosen for each ranking system should be regularly examined to avoid redundant biases.

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