Measuring the Stability of University Rankings in the Field of Education

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Abstract
The stability of ranking entities is one of the majorly discussed topics when concerning the ranking methodology. It is an important property which increases rankings reliability and credibility. Ranking of universities is, among others, an often examined topic in the terms of its stability, making the researchers worldwide agree that a statistically solid and firm ranking of universities is needed. This paper provides the stability analysis of the particular subject of the QS (Quacquarelli Symonds) World University Rankings compared to the University Ranking by Academic Performance (URAP). Namely, institutions that rank universities have turned the alertness from global academic rankings to more particular rankings in given scientific fields. In this paper, we particularly chose the field of Education, as one of the major factors that contribute to general well-being. We conducted the uncertainty and sensitivity analysis on the QS and URAP rankings in the field of Education to analyze the effects of their weighting schemes. The main goal of this paper is to compare the stability of QS and URAP ranking methodologies. Furthermore, we propose a Composite I-distance Indicator(CIDI) methodology as a tool for implementing the distinguishing innovations into the ranking methodology, in order to provide a more stable and solid ranking lists.

Keywords: education, university ranking, innovation, research, QS, URAP, ranking quality, knowledge, CIDI
JEL classification: I23

Introduction
People progress continuously throughout observation and learning, thus education and lifelong learning are very significantfor economic and social prosperities and are the major segments of human development (Dobrota and Benkovic, 2014; Dobrota et al., 2015). Most of the researchers, policymakers, and general public consider that education is not only for a certain period of life; thus, more than ever before, education has become a lifelong process in which individuals continue to learn in formal, non-formal, and informal environments throughout their lives (Blossfeld et al., 2011; Nguyen and Walker, 2016).In more recent times, lifelong learning has been identified with functional interests and economic goals (Fleming, 2011; Roche, 2015).It has also become a macro theme that is a central element of EU policy (Volles, 2016).

The main units that sustain education as well as the lifelong learning are universities, and they perform numerous actions in order to maintain competitiveness in the market. Since it is hard for individuals to examine and choose the best

institution to study at by themselves, many of them resort to public ranking lists of universities. Nowadays, university rankings and rankings of countries based on their scientific and educational performance are outstandingly noteworthy. To emphasize, the academic ranking of universities is a prominent modern concept, especially since the international competition have become of high priority for most world universities (Hazelkorn, 2013).

There is a wide range of methodologies that rank universities, and the publications from ranking officials are actively kept track of. Both public and researchers agree on the rising popularity of academic rankings (Uddin and Singh, 2014). Besides the most popular rankings such as Academic Ranking of World Universities(ARWU) or QS, there are others, such as URAP, that have drawn the attention of the academics(Alaşehir et al., 2014; Dobrota and Jeremic, 2016).

It is important to note that lately there has been a shift from global ranking lists towards ranking universities within a particular scientific field (Dobrota and Jeremic, 2016), nominated as "Rankings by Subject" (Cheng, 2015; Federkeil, 2015; Sowter, 2015). It proposes that many universities that do not perform remarkably well in global academic rankings play much better in particular academic fields.

Only couple of the ranking officials has introduced such an exhaustive analysis of "Rankings by Subject". Among those are the ranking lists which are the theme of our research: QS World University Rankings by Subject, which includes ranking lists for 36 different ranking fields, and URAP Filed Based Ranking, which provides 23 ranking lists.

As mentioned above, education and lifelong learning are of great significance to global prosperity and welfare. Thus as a case study, this paper observes rankings that consider the particular field of Education.

QS Education Ranking

QS World University Ranking focuses on a diversity of areas of interest, such as research, teaching, employability, and internationalization(QS Subject, 2016). QS global evaluates more than 800 universities in the world and includes 36 subjects as of 2015. The main goal of this variety of fields is to help future students in finding the world's leading schools in their chosen field of study (QS Subject, 2016).

Four major indicators create QS Education Ranking. Together with their weights in the field of Education, they are given in following list(QS Subject, 2016):

- *Academic Reputation* (50%) – QS's major global surveys of academics,
- *Employer Reputation* (10%)– QS's major global surveys of employers,
- *Citations per Paper* (20%) - research citations data from Scopus,
- *H-index Citations* (20%) - research citations data from Scopus.

URAP Education Ranking

URAP Ranking is based on academic performances of universities and determined by the quality and quantity of scholarly publications(URAP, 2016). The basis of URAP ranking methodology are publications: quality and quantity of publications, and international research collaboration performance (Dobrota and Jeremic, 2016). URAP global ranks 2000 world universities. With such an extensive outlook, URAP is quite comprehensive in coverage so that more universities could observe their academic progress (Alaşehir et al., 2014). This is why URAP's primary motivation lies in the number of universities covered by their ranking list (URAP, 2016).

There are five major indicators that URAP Education Ranking consists of. Together with their weights in the field of Education, they are given in following list (URAP, 2016):

- *Article* (25%),

- *Citation* (20%),
- *Article Impact Total (AIT)* (20%),
- *Citation Impact Total (CIT)* (25%),
- *International Collaboration* (10%).

The main goal of this paper is to compare the stability of QS and URAP ranking methodologies. This paper is organized as follows. Next section describes the methods used in this research. Results are presented in Section 3 and discussion is given in Section 4. Finally, the concluding remarks are given.

Methodology

The uncertainty and sensitivity analysis measuresthe stability of the ranking methodology(Cohen and Saisana, 2014; Paruolo et al., 2013; Saltelli et al., 2008). The uncertainty analysis confronts the influence of input indicators on the end composite indicator while the sensitivity analysis observes the effects of different model assumptions on the overall result. The analysis is based on the relative contribution of the indicators to each entity's score, whichcan provide useful information as to whether some indicators dominate the overall scores(Hoskins et al., 2015; Saisana and D'Hombres, 2008). The uncertainty and sensitivity of ranks have been previously used with a lot of success for the analysis of different university ranking methodologies(Dobrota and Dobrota, 2016; Dobrota et al., 2016; Saisana et al., 2011).

The relative contribution is calculated as a ratio of an indicator's score and the overall composite score multiplied by the appropriate indicator weight(Paruolo et al., 2013). Using the Monte Carlo simulation method, the score results are simulated, usually 1000 or 10000 times, using the average contributions and their standard deviations. By the uncertainty and sensitivity methodology (Saisana and D'Hombres, 2008), entity ranks are counted, thus measuring the amount of uncertainty in results.

Results

Mean relative contributions of indicators in the field of Education, as well as corresponding standard deviations of relative contributions, are given in Table 1 for QS Ranking, and Table 2 for URAP ranking.

As shown in Table 1, there are some differences among original weights and calculated relative contributions by uncertainty and sensitivity methodology. *Academic Reputation* is initially weighted 50% but has a bit lower relative contribution 43.5%. On the other hand, *Citations per Paper* is initially weighted 20% but has a bit higher relative contribution 25.5%. *Employer Reputation* and *H-index Citations* have more similar relative contributions to their original weights.

Table 1
QS Education Ranking Weights, Mean Relative Contributions, and SDs

Indicators	QS Education Weights	Mean Rel. Con.	Rel. Con. SD
Academic Reputation (AR)	0.5	0.435	0.04886
Employer Reputation (ER)	0.1	0.093	0.01778
Citations per Paper (CpP)	0.2	0.255	0.03073
H-index Citations (HiC)	0.2	0.217	0.02953

Source: Author's results, QS Subject (2016)

Table 2
URAP Education Ranking Weights, Mean Relative Contributions, SDs

Indicators	URAP Education Weights	Mean Relative Contribution	Rel. Con. Standard Deviation
Article	0.25	0.258	0.01418
Citation	0.2	0.200	0.00266
Article Impact Total	0.2	0.199	0.00280
Citation Impact Total	0.25	0.246	0.01429
International Collaboration	0.1	0.097	0.00785

Source: Author's results, URAP (2016)

Table 2 reveals that, as opposed to QS Education Ranking, URAP Education Ranking has much smaller, almost negligible differences between official weights and mean relative contributions. Also, if we compare the relative contributions standard deviations, we can see that they are much smaller for URAP than for QS Ranking. These results are suggesting that URAP will show greater stability in ranks, which will be investigated further in the text.

Table 3
Uncertainty and Sensitivity of QS Edu. Ranking for 15 Top Ranked Universities

University	1-3	4-6	7-9	10-12	13-15	16-18	19-21
UCL (University College London)	10000						
Harvard University	10000						
Stanford University	10000						
University of Cambridge		10000					
University of Oxford		9597	403				
University of California, Berkeley (UCB)		9642	358				
The University of Hong Kong		745	9255				
The University of Melbourne		1	9999				
The University of Sydney		15	9116	868	1		
University of California, Los Angeles (UCLA)			865	9135			
University of British Columbia			1	9999			
University of Toronto				7172	2828		
University of Michigan			3	2825	6912	260	
Columbia University					10000		
The Hong Kong Institute of Education				1	5142	4855	2

Source: Author's results

In the course of further research, the above-presented mean relative contributions, and their standard deviations were the inputs for Monte Carlo simulation while QS and URAP Education Ranking were simulated 10000 times. The results of uncertainty and sensitivity analysis are given in Table 3 (QS) and Table 4 (URAP).

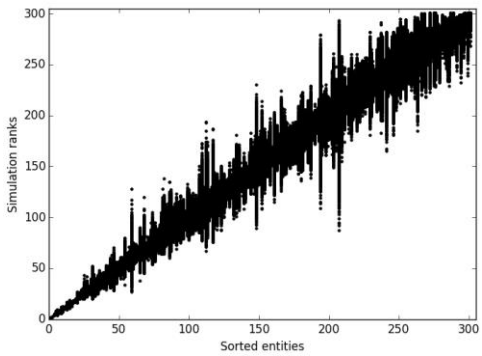
Table 4
Uncertainty and Sensitivity of URAP Edu. Ranking for 15 Top Ranked Universities

University	1-3	4-6	7-9	10-12	13-15	16-18	19-21
Harvard University	10000						
University of North Carolina Chapel Hill	10000						
University of Toronto	10000						
University of British Columbia		10000					
University of Maastricht		9996	4				
University of Minnesota		9958	42				
University of Michigan		4	9996				
University of Queensland		42	9958				
University of Washington Seattle			10000				
University of Sydney				10000			
Ghent University				10000			
University College London				9990	10		
Johns Hopkins University				10	9990		
University of California San Francisco					10000		
University of Texas Austin					10000		

Source: Author's results

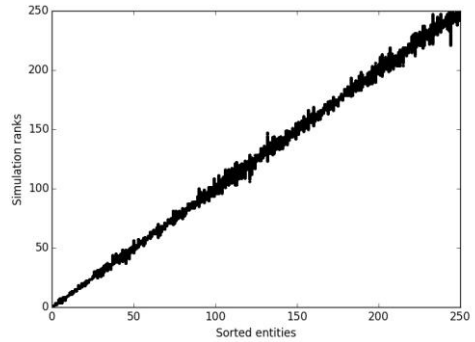
The results of uncertainty and sensitivity analysis, for the whole list of examined universities, are given in Figure 1 and 2.

Figure 1
Uncertainty and Sensitivity of QS Education Ranking



Source: Author's illustration

Figure 2
Uncertainty and Sensitivity of URAP Education Ranking



Source: Author's illustration

Discussion

The assessment of universities in the field of Education granted different significant findings. We have uncovered that, as opposed to QS Education Ranking, there was a lower level of uncertainty and sensitivity in the results of URAP Education Ranking, which was far more stable with a sparse degree of sensitivity to different model premises.

From Table 3 it can be seen that University College London (UCL), which is best ranked according to QS Education Ranking, as well as Harvard and Stanford, are found in positions from 1-3 in all 10000 simulations while Cambridge is in places 4-6 in all 10000 simulations. Other universities show a certain amount of uncertainty as we continue along the table to lower positions. Thus, for example, The University of Sydney is found in a range of positions to 4 to 15 while the University of Michigan is found in a range of positions to 7 to 18, and so on.

Table 4 shows that URAP Education Ranking exhibits a lower amount of uncertainty of the ranks. It is clear that universities ranked according to URAP have much more stable positions than if ranked according to QS. This is even more evident from the fact that first 15 universities only vary among positions 1 to 15.

These disparities are even clearer from Figure 1 (QS) and 2 (URAP). Figure 1 shows that, even if somewhat stable for higher positions, ranks are very unstable for middle and lower positioned universities. Figure 2 reveals that URAP ranking positions are far more stable for all higher, middle, and lower ranked universities.

Conclusion

This paper gave a detailed analysis of uncertainty and sensitivity of two major university ranking lists. Our results unveil that, even if the QS Ranking is far more famous and prominent than URAP Ranking, it shows a larger amount of uncertainty and sensitivity. URAP, on the other hand, is more stable and robust throughout all the ranking results: for higher-ranked, middle-ranked, and lower-rankeduniversities. This finding makes the URAP Ranking competent and ready to enter a prestigious list of most popular world university rankings(Dobrota and Jeremic, 2016).

Further research directions include extracting the rationales for the disparities found in this research. The authors propose the application of a particular ranking methodology, CIDI, and thus a proper alteration of rankings. CIDI establishes different weights for each of the individual indicators, which are not given by experts but rather extracted from the data itself. CIDI proved to be more stable than original

weights in a number of situations (Dobrota and Dobrota, 2016; Dobrota and Jeremic, 2016; Dobrota et al., 2016).

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