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COMPARISON OF RANKINGS OF TURKISH FOUNDATION UNIVERSITIES: TIMES HIGHER EDUCATION WORLD UNIVERSITY RANKINGS AND EVAMIX APPRAISAL SCORE RANKINGS

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ABSTRACT

In recent years, the number of foundation universities has increased, leading to a higher level of competition among universities, which in turn causes universities to invest more effort in improvements. For comparison, universities take into consideration various rankings that are internationally recognized and publicly shared. The Times Higher Education World University Rankings (THEWUR) is considered to be one of the most recognized. This study examines five Turkish foundation universities that are in the top 1000 in the THEWUR and are also included in the Report for Higher Education Foundation Institutions published by the Council of Higher Education (CHE) in 2018. In this application, criteria other than those used in THEWUR are used, and these universities are reordered using the EVAMIX method, one of the multi-criteria decision-making methods. The rankings obtained are interpreted in comparison with the THEWUR.

Keywords: THEWUR, foundation universities, EVAMIX, CRITIC method

1. INTRODUCTION

Universities have three fundamental duties: education, research, and service. Of these duties, service is in another dimension because it also includes service to the region in which the university is located. Universities address the educational need of students in their region and also contribute to the socioeconomic development of the region. In establishing new universities, Turkey takes into account the fact that members of a growing young population want to receive a higher education; Turkey also considers the possible contributions the universities can make to the city in which they are to be built, thus aiming to eliminate inequality among Turkish regions (Sargın, 2007). With these objectives, foundation universities were established along with state universities. The first foundation university is Bilkent University, which was established in 1984. From this date forward, the establishment of foundation universities has continued; numbers reached a peak in the 2000s and are still increasing.

In recent years, as the number of foundation universities have increased, prejudiced ideas entered the public's attitude regarding the quality of these universities. The main reason for this prejudice is that some of the foundation universities are managed like a "private" university. Moreover, the increase in competition between foundation universities fueled by their increasing numbers also formed the basis for such prejudices. The Council of Higher Education (CHE) published a report on higher education foundation institutions for the first time in 2018 in order to eliminate these prejudices and honestly present the strengths and weaknesses of foundation universities. This report evaluates foundation universities in academic, financial, and administrative terms. This report also includes information on achievement

rankings in certain examinations by the Student Selection and Placement Center (SSPC), places in national and international university rankings, the Entrepreneurial and Innovative University Index, the number of projects with TUBITAK-ARDEB, meetings, workshops, and on-site visits (Yükseköğretim Kurumu, 2018).

Foundation universities must be superior to other universities in many areas in order to attract students. The most important area in which they have to outperform others is educational activities. Gaining the top position in such areas have helped many foundation universities to gain recognition at the international level. In the Report on Foundation Higher Education Institutions, five Turkish foundation universities achieved a ranking in the top 1000 in the Times Higher Education World University Rankings, one of the most prestigious rankings. These universities are Koc, Sabanci, Bilkent, Atilim Universities, and the TOBB University of Economics and Technology, respectively.

The Times Higher Education Magazine has been publishing THEWUR since 2003. The original purpose for this ranking was to help those students who want a higher education abroad to make a decision based on the current position of all world universities (Saka & Yaman, 2011). This ranking is based on evaluations in the areas of teaching, research, citations, international outlook, and industry income. Although there are many rankings of world universities, the ranking most referred to is the THEWUR (Stack, 2013).

The objective of this study is to rank the Turkish foundation universities that placed in the top 1000 in the THEWUR using the EVAMIX method based on criteria given in the Report on Higher Education Foundation Institutions and to compare this ranking to the THEWUR.

2. MATERIALS AND METHODS

This section of the study explains in detail the data source and the EVAMIX and CRITIC methods used.

2.1. Data Source

The study uses data from the Report on Higher Education Foundation Institutions which was published for the first time in 2018. The report consists of five parts. The first part gives some brief information and evaluates higher education foundation institutions. In this part, information is first presented about which foundation the institutions are affiliated with, the year of establishment, the year educational activity started, and the city in which they are located. This was followed by the number of academic units, the total number of students, the number of permanent academic staff, the number of students per permanent academic staff, the number of books published, the number of e-books published, the library area, the library area per student, the ratio of full scholarship students (determined according to SSPC) metadata, excluding discounts),the current expenditure per student, and the ratio of contribution from students to total income (financial data is from 2016-2017 inspection reports).

The second part of the report presents statistics on higher education foundation institutions. This part shows tables and charts formed using the variables in the first part. It also includes information such as foundation universities that have a law faculty, a medical faculty, or a pharmacy faculty.

The second part of the report consists of two subtopics. The first subtopic presents the various rankings of foundation universities, showing the foundation universities that are in rankings recognized worldwide, including QS World University Rankings, QS World University Rankings by Subject, QS Emerging Europe and Central Asia University Rankings, and the THEWUR. These rankings are then followed by the URAP Rankings (University Rankings by Academic Performance). Also presented are the rank of foundation universities by years in the ranking of the Entrepreneurial and Innovative University Index. In addition to the rankings, it also includes a list of accredited programs and statistical information on TUBITAK-ARDEP projects at foundation universities. The second subtopic gives information and rankings by achievement in terms of student scores on various entrance examinations, the ALES, the E-YDS, and the KPSS. It also includes the ratio of candidate students placed in undergraduate programs with DGS to those with TUS placements.

The fourth part of the report presents improvements in the process of establishment, in student admission and evaluation, in education, in inspection, and in other processes of foundation universities; and in communication with higher education foundation institution authorities. The last part of the report shows various visuals from workshops during the process of creating the report and performing of on-site investigations (Yükseköğretim Kurumu, 2018).

This study examined the Turkish foundation universities ranked among the top 1000 in the THEWUR. To rank universities, the THEWUR uses five dimensions and 11 indicators: Teaching (reputation survey, staff to student ratio, doctorate-to-bachelor's ratio, the ratio of doctorates awarded to academic staff, institutional income) Research (reputation survey, research income, research productivity), Citations, International Outlook (proportion of international students, proportion of international staff, level of international collaboration) and Industry Income (Times Higher Education). Since the results of this study will be compared to the THEWUR, we aimed to determine a criterion to represent each dimension. The selected criteria are the number of students per permanent academic staff for the dimension of Teaching, the total scientific document points for the dimension of Research, and the URAP ranking for the dimensions of Citations and International Outlook. The URAP ranks universities based on the dimensions of number of published articles, the total number of citations per document, the total impact of articles , the total impact of citations, and international collaboration (URAP TURKEY, 2018). Lastly, the Entrepreneurial and Innovative University Index was selected to represent the dimension of Industry Income. This ranking is created annually by TUBITAK. It consists of five dimensions and 23 indicators. These dimensions are competence in scientific and technological research, the intellectual property pool, collaboration and interaction, entrepreneurship and innovation culture, and economic contribution and commercialization (TÜBİTAK, 2018). In addition to these variables, this study also uses the variables of total area per student and current expenditure per student which are believed to be significant in ranking universities.

3. EVAMIX and CRITIC Methods

Multi-criteria decision-making methods that aid in ranking units with different criteria have been commonly used in recent years. One of such methods is the EVAMIX method (Evaluation of Mixed Data) which was developed by Voogd in 1981. In the EVAMIX method, the decision matrix involves both quantitative and qualitative data (De Montis, De Toro, Droste-Franke, Omann, & Stagl, 2004).

The application of the EVAMIX method is based on the determination of unique pairs of alternatives and consideration of the dominance of each alternative pair. The ranking is then formed by assigning the weighted sum of dominance scores to each alternative (Darji & Rao, 2013).

The step-by-step process is as follows:

Step 1: The decision matrix in which m is the number of alternatives and n is the number of criteria is formed to have dimension (mxn) and shown below.

$$X = [X_{ij}]_{mxn} = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & \dots & x_{mn} \end{bmatrix} \quad (1)$$

Step 2: It is determined whether each criterion is beneficial or non-beneficial, followed by the normalization process.

If the criterion is determined to be beneficial,

$$r_{ij} = \frac{x_{ij} - \min(x_{ij})}{\max(x_{ij}) - \min(x_{ij})}, \quad i = 1, 2, \dots, m \; ve \; j = 1,2, \dots, n \quad (2)$$

If the criterion is determined to be non-beneficial,

$$r_{ij} = \frac{\max(x_{ij}) - x_{ij}}{\max(x_{ij}) - \min(x_{ij})}, \quad i = 1, 2, \dots, m \; ve \; j = 1,2, \dots, n \quad (3)$$

With these operations, normalization is complete (Aytaç Adalı, 2016).

Step 3: In this step, each ordinal and cardinal variable pair will be compared to each other. This comparison requires the use of criterion weights. Different techniques are used at this stage in the literature. This study will use the CRITIC (Criteria Importance Through Inter-criteria Correlation) method to determine weights.

The CRITIC method involves finding the values of standard deviation and correlation of each criterion after applying steps 1 and 2. The weight is calculated using the values below (Diakoulaki, Mavrotas, & Papayannakis, 1995).

$$C_j = \sigma_j \sum_{k=1}^{n} (1 - \rho_{jk}) \qquad j = 1, \dots, n \tag{4}$$

$$w_j = \frac{C_j}{\sum_{k=1}^{n} C_k} \qquad j = 1, \dots, n \tag{5}$$

Here σ_j is the standard deviation of j[th] criterion, and ρ_{jk} is the correlation coefficient between j[th] and k[th] criteria.

Step 4: The dominance score for each alternative pair is calculated with equation 6 if they are ordinal criteria or with equation 7 if they are cardinal criteria.

$$\alpha_{ii'} = \left[\sum_{j=0} \{w_j sgn(r_{ij} - r_{i'j})\}^c\right]^{1/c} \tag{6}$$

and

$$sgn(r_{ij} - r_{i'j}) = \begin{cases} +1 & if\ r_{ij} > r_{i'j} \\ 0 & if\ r_{ij} = r_{i'j} \\ -1 & if\ r_{ij} < r_{i'j} \end{cases}$$

$$\gamma_{ii'} = \left[\sum_{j \epsilon c} \{w_j sgn(r_{ij} - r_{i'j})\}^c\right]^{1/c} \tag{7}$$

In these equations, $\alpha_{ii'}$ and $\gamma_{ii'}$ are dominance scores for ordinal and cardinal criteria, respectively, w_j is the weight, and *r* represents the normalized values (Ulutaş & Cengiz, 2018).

Step 5: The dominance scores obtained are standardized with the following equations according to their state being whether ordinal or cardinal.

The standardized ordinal dominance score is calculated as

$$\delta_{ii'} = \frac{\alpha_{ii'} - \alpha^-}{\alpha^+ - \alpha^-} \tag{8}$$

The standardized cardinal dominance score is calculated as

$$d_{ii'} = \frac{\gamma_{ii'} - \gamma^-}{\gamma^+ - \gamma^-} \tag{9}$$

In these equations, the values α^+ and α^- represent the highest and lowest ordinal dominance scores for alternative pairs, respectively, and the values γ^+ and γ^- represent the highest and lowest cardinal dominance scores for alternative pairs, respectively.

Step 6: The overall dominance score $D_{ii'}$ for each alternative pair is calculated as follows:

$$D_{ii'} = w_0\delta_{ii'} + w_c d_{ii'} \quad (10)$$

Here, w_0 is the weights sum for ordinal criteria, and w_c is the weights sum for cardinal variables.

Step 7: Appraisal scores are calculated.

$$S_i = \sum_{i'} \left(\frac{D_{i'i}}{D_{ii'}}\right)^{-1} \quad (11)$$

It is accepted that the alternative with the highest appraisal score has the best performance. Along with this information, the alternatives are ordered from highest appraisal score to lowest appraisal score, or in other words, from best to worst.

4. IMPLEMENTATION

The Turkish Universities in the top 1000 among the higher education institutions rankings by THEWUR were examined based on the data in the Report on High Education Foundation Institutions published by CHE in 2018. The THEWUR uses criteria in five different dimensions. The foundation universities in the top 1000 according to these criteria are ranked in Table 2. However, based on the idea that these rankings might be subjective and can change if comparison criteria are changed, the dimensions in THEWUR were considered and the relevant universities were re-ordered with different criteria using the EVAMIX method. Table 1 shows the criteria used.

Table 1. Criteria used in the Research

Criteria	Description
C1	Number of Students Per Permanent Academic Staff
C2	Total Area Per Student
C3	Current Expenditure Per Student
C4	URAP Ranking Among Foundation Universities
C5	Entrepreneurial and Innovative University Ranking 2017
C6	Total Score of Scientific Documents

These criteria are selected from among the variables used in international university rankings such that each criterion represents a dimension in which they will be compared to the THEWUR. Additionally, the URAP rankings and the Entrepreneurial and Innovative University rankings are also included in the study since they enable various characteristics to be considered collectively. Along with this information, values of the variables obtained, in other words, the decision matrix, is shows in Table 2.

Table 2. **Variables used in the Research and Alternatives Ranking within THEWUR**

Alternatives		C1	C2	C3	C4	C5	C6
A1	Koç University	12,38	70,2	60087	2	7	163,83
A2	Sabancı University	14,95	263,14	51610	3	1	161,14
A3	Bilkent University	18,57	255,58	27393	1	6	172,57
A4	Atılım University	16,98	37,81	8915	6	11	124,57
A5	TOBB University of Economics and Technology	19,87	47,71	17581	7	13	120,93

Of these criteria, place among foundation universities in the URAP rankings (C5) and place in the Entrepreneurial and Innovative University Ranking (C5) are determined to be qualitative, and the others are determined to be quantitative criteria.

Examining the criteria, it is desired to minimize the criteria C1, C4, and C5. In other words, these are non-beneficial criteria. The criteria C2, C3, and C6 can be considered beneficial criteria. Table 3 shows the decision matrix normalized using equations (2) and (3) in line with the above information.

Table 3. Normalized Decision Matrix

Alternative No	C1	C2	C3	C4	C5	C6
A1	1,000	0,144	1,000	0,833	0,500	0,831
A2	0,657	1,000	0,834	0,667	1,000	0,779
A3	0,174	0,966	0,361	1,000	0,583	1,000
A4	0,386	0,000	0,000	0,167	0,167	0,070
A5	0,000	0,044	0,169	0,000	0,000	0,000

After calculating the correlation among criteria and their standard deviation, the weight is obtained using equation (4) and (5) with the CRITIC method and is shown in Table 4.

Table 4. Objective Weight of Criteria

Criteria No	C1	C2	C3	C4	C5	C6
w_j	0,224	0,251	0,156	0,132	0,113	0,123
C_j	1,058	1,183	0,734	0,624	0,532	0,582

Using CRITIC weights obtained, dominance scores for each alternative pair are calculated using either equation (6) for ordinal criteria or equation (7) for cardinal criteria, as explained in step 4 in the method section. These are presented in Table 5.

Table 5. Dominance Scores of Alternative Pairs

Pairs	$\alpha_{ii'}$	$\gamma_{ii'}$	Pairs	$\alpha_{ii'}$	$\gamma_{ii'}$
1,2	0,020	-0,106	3,4	0,245	0,366
1,3	-0,245	0,058	3,5	0,245	0,424
1,4	0,245	0,424	4,1	-0,245	-0,424
1,5	0,245	0,481	4,2	-0,245	-0,529
2,1	-0,020	0,106	4,3	-0,245	-0,366
2,3	-0,020	0,163	4,5	0,245	0,058
2,4	0,245	0,529	5,1	-0,245	-0,481
2,5	0,245	0,587	5,2	-0,245	-0,587
3,1	0,245	-0,058	5,3	-0,245	-0,424
3,2	0,020	-0,163	5,4	-0,245	-0,058

In the next stage of the study, the dominance scores are standardized as shown in Table 6.

Table 6. Standardized Dominance Scores of Alternative Pairs

Pairs	$\delta_{ii'}$	$d_{ii'}$	Pairs	$\delta_{ii'}$	$d_{ii'}$
1,2	0,540	0,410	3,4	1,000	0,812
1,3	0,000	0,549	3,5	1,000	0,861
1,4	1,000	0,861	4,1	0,000	0,139
1,5	1,000	0,910	4,2	0,000	0,049
2,1	0,460	0,590	4,3	0,000	0,188
2,3	0,460	0,639	4,5	1,000	0,549
2,4	1,000	0,951	5,1	0,000	0,090
2,5	1,000	1,000	5,2	0,000	0,000
3,1	1,000	0,451	5,3	0,000	0,139
3,2	0,540	0,361	5,4	0,000	0,451

The overall dominance scores are calculated using equation (10) with standardized dominance scores and are shown in Table 7.

Table 7. Overall Dominance Scores of Alternative Pairs

Pairs	$D_{ii'}$	Pairs	$D_{ii'}$
1,2	0,442	3,4	0,858
1,3	0,414	3,5	0,895
1,4	0,895	4,1	0,105
1,5	0,932	4,2	0,037
2,1	0,558	4,3	0,142
2,3	0,595	4,5	0,660
2,4	0,963	5,1	0,068
2,5	1,000	5,2	0,050
3,1	0,586	5,3	0,105
3,2	0,405	5,4	0,340

At the end of all these analyses, appraisal scores are calculated using equation (11) and shown in Table 8.

Table 8. Appraisal Scores and Ranking of Alternatives

Results	A1	A2	A3	A4	A5
Scores	0,349	0,641	0,406	0,024	0,023
Ranking (EVAMIX)	3	1	2	4	5
THEWUR with respect to each other	1	2	3	4	5

Examining the ranking with EVAMIX, the place of the first three universities in the ranking changed, and the last two universities maintained their position. Hence, the rankings of these universities by the criteria determined are as follows: Sabanci University, Bilkent University, Koc University, Atilim University, and TOBB University of Economics and Technology.

5. CONCLUSIONS

As the number of foundation universities increase, students who wish to study in these universities have more difficulty in deciding which university to study. At this stage, news stories about these universities and national and international rankings help students make a decision.

The increase in the number of foundation universities have beneficial outcomes for the region in which they are located, but this increase also causes problems with respect to quality. CHE aimed to present the general condition at these universities, and, in 2018, published the Report on Foundation Higher Education Institutions. With the help of this report, universities can learn their strengths and weaknesses, view their place among other universities, and make their own policies accordingly. The report also contributes to the resolution of the quality problem. Therefore, the Report on Foundation Higher Education Institutions is beneficial for both foundation universities and students who will select a foundation university.

This study ranks the Turkish Foundation Universities among the top 1000 in THEWUR using the EVAMIX method based on various criteria determined in the Report on Foundation Higher Education Institutions that represent variables used in THEWUR. The EVAMIX method, which is one of the multi-criteria decision-making methods, aids with ranking alternatives and is based on calculating dominance scores for each alternative in cases where there are ordinal and cardinal data. It is known that calculation of dominance scores requires the use of weights. While there are many different methods for calculating weight, this study uses the CRITIC method.

As a result of this study, the ranking created with the EVAMIX method is as follows: Sabanci University, Bilkent University, Koc University, Atilim University, and TOBB University of Economic and Technology. The ranking in the THEWUR is as follows: Koc University, Sabanci University, Bilkent University, Atilim University, and TOBB University of Economics and Technology. As can be seen, the position of the last two universities remains the same while the position of the first three changed.

Looking at Sabanci University which is placed first in the EVAMIX ranking, it has the largest area per student and is placed first in the entrepreneurial and innovative university ranking. Koc University is placed first in the THEWUR, and third in the ranking with the EVAMIX method. The most logical reason for this was that it has a smaller area per student.

To conclude the study, it can be stated that the rank of a university may change with varying criteria and with the application of different methods. Consequently, a university placed first in a ranking may have a much lower position in another ranking.

We believe that this study contributes to the literature because it is the first study that uses the EVAMIX method to rank universities. Future studies may use different criteria and different multi-criteria decision-making methods and compare the results.

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