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Research Article

Winning and Losing Relationship: A New Method of University Ranking in the Case of Countries along the Belt and Road

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From the perspective of the complex system, university ranking is a complex system that involves multiagent actors, which evolve over time. Yet, current major university rankings fail to reflect the system dynamics of the university innovation system. In this paper, we apply the complex system model in the field of the university innovation system in the context of university ranking in the countries along the Belt and Road, which is a long-term overlooked field. We introduce a new method of university ranking based on the "winning and losing" relationship to measure the relative competitiveness between universities. This paper contributes to complex system research, the Belt and Road research, and the university ranking arena.

1. Introduction

University rankings (or college and university rankings) are rankings of institutions in higher education based on various combinations of various factors [1, 2]. As a common way to rank and evaluate universities, university rankings reflect the research quality, teaching quality, and a variety of other aspects of universities, thus could act as a reference for students' school choice or even as an evaluation index for a country's competitiveness in education and innovation [3]. For home students and international students, the role of university rankings is also different. The former mainly uses them to supplement existing information, while the latter uses rankings as an important decision-making basis [4]. In addition to the significant role in the national system of innovation, universities also play a major role in the regional innovation system or contribute to the whole society by formulating a university innovation ecosystem. Prior literature mainly focuses on the role of universities in the national or regional innovation system, such as a triple helix of the university-industry-government linkages [5–7], yet overlooking the system dynamics inside of the university innovation ecosystem [8, 9]. From a complex system perspective [10–12], each university is an agent actor in the university innovation ecosystem [13, 14]; thus, the evolution [15], the relative interdependence between each actor [16], and the interaction between actors should be the top topic of studies on the university innovation ecosystem and thus should be considered in university rankings. However, although there are several major global university rankings, none of them have taken the complex system models into account, thus failing to reflect the complex and dynamic nature of the university ecosystem. At present, due to the limitations of measurement indicators, mainstream university rankings do not play a significant role in promoting the quality of higher education [17]. In this paper, we introduce a new method of university ranking based on complex system models and apply the new method in a new field that current major university rankings have overlooked for decades.

In 2013, China adopted the Belt and Road Initiative (hereafter, BRI) as a global infrastructure development strategy, covering nearly 70 countries in Asia, Africa, Europe, the Middle East, and America. As an initiative

aiming to "enhance regional connectivity and embrace a brighter future," the BRI has signed or developed 200 cooperation documents in 138 countries and 30 international organizations as of 2020. Building a regional university consortium or union is one of the major goals of the BRI [18]. With the closer cooperation between the BRI countries, the academic cooperation and knowledge flow between the BRI universities are also increasing. Thus, the mutual understanding between the BRI universities is in need to further enhance collaboration and communication. Yet, due to the long-term ignorance of the BRI countries, academia knows very little about the status and relative competitiveness of the BRI universities. In this paper, we apply our new method of university ranking in the BRI countries. This is the first time to rank universities in the BRI countries. This paper contributes to the BRI research by introducing a near-holistic system covering as much the BRI universities as possible, and by so doing offering a systematic view to examine and evaluate the relationship between the BRI universities.

The remainder of this paper is organized as follows. Section 2 reviews the current research on the university innovation system and cross-border academic talents' flow and then discusses the role of universities from countries across the Belt and Road and the deficiencies of current university ranking for neglecting these universities. Section 2 also reviews the literature on the university ranking from the perspective of a complex system and proposes the "winning and losing" relationship as a new method for university ranking. Then, model construction and methodology are reported in Section 3. Section 4 reports our data collection process. Next, the model results are studied in Section 5. Finally, Section 6 concludes the paper.

2. Literature Review and Theoretical Framework

2.1. The University Innovation System and Cross-Border Talents' Flow. With the in-depth development of globalization globally, the scale of education globalization has also expanded tremendously. The free flow of higher education and human resources has become a common phenomenon worldwide. The flow of talents tends to go to higher education institutions with higher education and higher quality. Under this circumstance, competitiveness has become one of the goals that the world's universities strive to pursue [19], making the world university ranking a significant demand for higher education institutions [20]. The university rankings provide references for students, researchers, policymakers, and other stakeholders to allocate educational resources, the choice of institutions, and other relevant issues.

More and more university rankings begin to appear in people's vision. The evaluation criteria and indicators they apply to are varied. However, various university rankings mainly use quantitative and qualitative indicators to evaluate three aspects of the development level of higher education institutions. Some use the student-student ratio, employer reputation, etc., to reflect the teaching level of colleges and universities [21] and use papers published and cited, academic standing, and the number of academic staff to reflect the achievements of academic research. Some rankings use the number of international students to demonstrate the degree of internationalization. More and more institutions evaluate and rank universities in recent years; the ranking content and methodology gradually become diversified. However, in the current world university rankings, some university rankings such as ARWU, NTU, and URAP, their ranking indicators, and methods show high similarity [22], so many people are trying to improve and synthesize the existing rankings using their own methodology, such as the introduction of entrepreneurial orientation [23], meta-ranking [24], and ranking aggregation [25]. In the process of specific ranking, the method of weighting and maximal normalization are extensively used to calculate the scores of each institution. However, there are still many problems in the current university rankings.

2.2. The Role of Universities from Countries across the Belt and Road in the World University Innovation System. Although the BRI countries are indispensable members of the world economy, most universities in the BRI countries are neglected in the current university rankings for decades. However, it is important to note that these universities also play an essential role in the global higher education and innovation system. Meanwhile, these universities play an indispensable role in their home countries.

There are four major global university rankings now: QS ranking, Leiden ranking, ARWU, and U-Multirank. The QS (Quacquarelli Symonds) World Ranking of Universities (hereafter, QS ranking) assesses university performance based on six indicators, including academic reputation, citations per faculty, student-to-faculty ratio, employer reputation, international faculty ratio, and international student ratio [19–21]. The QS ranking was first published in 2004 and was the result of the collaboration between the QS and the Times (the Higher Education edition, hereafter, THE). Yet, after the suspension of cooperation with the Times in 2009, QS and THE released their university rankings independently since 2010, but these two systems still use very similar indicators and calculation methods. The main shortcoming of the QS and THE ranking is they both neglect the importance of educational performance. Although they intend to measure the quality of teaching through a reputation survey, their results are easy to be influenced due to the lack of accuracy of the survey method. The two most important indicators in the QS and the ranking (academic reputation and employer reputation; these two indicators account for half of the weights) are based on global surveys [26, 27]. Yet, these surveys cannot reflect the exact quality of academic research and education due to the limited data, the subjective measurement, and the lack of transparency, which makes these two indicators highly problematic. Moreover, most of these ranking indicators are more beneficial to large-scale universities or those with large research funds [28]. Although many use quantitative methods such as PageRank to construct a citation

network to measure reputation, however, such methods can only show the academic reputation of the institution rather than the overall reputation [29, 30].

The Academic Ranking of World Universities (hereafter, ARWU), formerly known as the Shanghai Jiao Tong index, is published annually by the Institute of Higher Education and Shanghai Jiao Tong University since 2003. Each year, ARWU ranks more than 1800 universities and publishes their top 1000. The indicators in ARWU ranking include number of alumni winning Nobel Prizes and Fields Medals, number of staff winning Nobel Prizes and Fields Medals, number of highly cited researchers in 21 broad subject categories, number of articles published in Nature and Science, number of articles indexed in Science Citation Index Expanded (hereafter, SCI-E) and Social Sciences Citation Index (hereafter, SSCI), and per capita academic performance of an institution. Because ARWU mainly focuses on academic performance, it inevitably fails to reflect the overall performance of the university [28]. Meanwhile, there are certain problems in the accuracy of academic publications and citation data [31]. Because of different biases towards the academic-level evaluation indicators, the ranking results of the academic level in the same school are quite different [32]. The measurement of academic achievements still requires more sophisticated quantification or calculation methods.

The Leiden Ranking was first published in 2009 [32], focusing on the academic performance of the university, and does not take the quality of teaching into consideration at all [31]. The Leiden ranking, therefore, could only reflect the level of scientific research and fails to picture the overall performance of universities. At the same time, the Web of Science (hereafter, WOS) publication and citation data are used in the Leiden Ranking, which are also inaccurate [33]. However, this method relies too much on the publication and citation of academic papers [34], and one of the results it brings is active academic performance management. This has led many higher education institutions to choose the universities and colleges in their own countries or countries where higher education is well developed to conduct academic cooperation and paper publication to increase the number of papers published and cited, thus improving their performance in ranking [35]. However, this approach will bring negative effects to the publicity of universities [36].

The U-Multirank was first published in 2014, combining the WOS citation data from the Leiden Ranking and students' survey as from the QS and THE ranking [28, 37]. Yet, the U-Multirank still has a problem with indicator redundancy. Too many indicators are also one of the main problems in the current university rankings. The overdetailed indicators make it hard for stakeholders to understand and make decisions based on the U-Multirank.

In addition to the above deficiencies, current university rankings still fail to reflect the dynamic mechanisms of the university innovation ecosystem. These problems have largely caused certain obstacles to the choices of institutions for stakeholders. For the colleges themselves, it also caused a lopsided pursuit of academic performance neglecting the quality of teaching, which has a certain negative impact on the healthy development of higher education [38]. Therefore, it is necessary to propose a new method of university ranking with simple indicators, which can effectively and dynamically measure the actual quality and performance of universities with robust results [21, 29, 39, 40].

2.3. The "Winning and Losing" Relationship in the Complex University Innovation System. This study proposes a new ranking method called the "winning and losing" relationship, which will take the undergraduate, postgraduate, and doctoral students' career progression or employment tendencies as the main indicators to measure the performance of universities in education. Our indicators include the net inflow of talents in each university's talent flow, the university's level of competitiveness, and the relative talent flow at each stage. The factors that affect the flow of academic talents are usually diverse, including various uncertain factors, such as the impact of epidemics on the flow of talents. Historically, pandemics may indeed affect the flow of talents, including the current COVID-19 and the closure of higher education institutions in some countries after the outbreak, which will affect people's mobility choices to a certain extent and partly affect the university ranking's accuracy. However, the data for this study were collected in 2019. The data on academic talents are mainly those born after 1950. The epidemic which has the impact that is similar to the pandemic and can change the trajectory of academic talents on a large scale does not exist in the interval. Thus, the influence of pandemics will not be taken into the consideration in this research.

In addition to the disorderly flow of talents that may be caused by government intervention, epidemics, and education agreements, which affect the scientific nature of this evaluation, there are many other factors that affect the flow of academic talents. However, the innovation of this article is precise that it does not specifically consider these traditional factors of the flow of academic talents. Instead, it starts with the final selection of academic talents for ranking construction. In fact, there are many uncertain factors (not mentioned in the previous literature) that may affect the flow of talents, but usually, the impact is partial, small-scale, and periodic. The study based on the large database still has the positive value of scientific research and method innovation.

The main theoretical basis of the research is the rational choice theory, which has been widely used in economics, sociology, law, and other fields for many years as a theory of research on the choice of human behavior strategies [41, 42]. In rational choice theory, rationality is the instrumental rationality that explains the connection between an individual's purposeful action and the outcome it can achieve. The rational choice theory generally considers that the individual is the rational person, that is, the pursuer of his own best interests, and intellectually believes that different choices will lead to different results [43]. There are different behavioral strategies to choose from in a particular situation. At this time, subjectively, people will have different preferences for different selection results [44]. And people generally tend to choose the optimal strategy, that is, the

strategy with the lowest cost or the highest benefit [45]. Of course, there are people who criticize the scientific nature of rational choice theory. Criticism of this theory mainly focuses on assumptions. Many believe that rational choice theory has flaws in assumptions, and its basic assumption, that is, the hypothesis of "economic man," does not conform to reality. They believe that rational choice theory pays too much attention to the influence of psychological factors on the continuity of behavioral choices, making this theory well received. However, in this study, students' choice of further studies and employment is largely influenced by psychological factors, especially the expectations about the target colleges and universities. Students are obviously more inclined to be within the range of choices to go to better colleges to conduct further studies [46].

Based on the research ideas of this theory, we analyze the behavioral orientation of students' choice of school and propose a method of the "winning and losing" relationship.

The "winning and losing" relationship means the comparison of the trend of talent flow between the two universities, which university is more preferred by talents. Educational agreements between countries, especially agreements on mutual recognition of credits, enrollment quotas, scholarships, etc., can affect the flow of academic talents greatly. Even so, education agreements still contain students' mobility options. If the quality or reputation of the counterparty is lower than the student's previous degree, the mobility is still difficult to occur on a large scale. However, there may indeed be reverse inflow situations. For example, in China, a small number of undergraduates from Peking University choose Wuhan University or Fudan University to study for a master's degree. However, the number is very small, and the influence of a small number of small samples on the research results can be avoided through increasing sample size.

As mentioned above, there is indeed a small number of nonregular mobility of academic talents, which may be related to human intellectual factors or other factors that are not related to the quality of higher education, such as the ability of people to obtain information. Even so, a large database can still reflect the mobility choices of the vast majority of people, rational choice theory is still applicable, and university rankings based on the large database and rational choice theory are still highly applicable.

In this research, we apply a two-to-two comparison to all of the universities we surveyed, which will provide the "winning and losing" relationship of each university and the net inflow of talents. Then, we add the results together, and based on that, we calculate the total net inflow of talents. This methodology aims to rank colleges and universities by measuring the trend of the talents of colleges and universities. Our method can reflect the system dynamics in the university innovation system [47, 48], with relatively stable and simple indicators and objective data sources.

As for reputation, the reputation of a university directly reflects its public image [49] and perception [50]. As a very important indicator of university rankings, which is mentioned above, reputation is very difficult to quantify. There are plenty of methods to evaluate the reputation of universities, such as questionnaire and survey, which are mentioned above. Chen put forward 24 criteria for evaluating the reputation of universities [51], which are of great value. However, the innovation of this article lies in that the traditional reputation evaluation is more partial, and various indicators are used to try to calculate the reputation of the university. Meanwhile, it is easily ignored that value creation behaviors of talents and college students [52] also play an important role in promoting the reputation of universities. This article follows the idea of "gestalt," emphasizes the overall evaluation plan of the university reputation, and applies large database analysis of academic talents "voting with their feet" to quantify the reputation, which is fundamentally different from previous research, including Chen's.

3. Model Construction

This study is based on Coleman's analysis of rational choices, starting with the students' individual choice behaviors and constructing university metrics from the perspective of students' choices of colleges [41, 42]. With the development of the internationalization of higher education, students' choices of colleges are mainly a kind of individual behavior; students can freely choose to study or work in different institutions and are basically not bound by social systems. In addition, students who choose to continue their studies or work are the choices for graduation. The preferences of students who choose the same kind of destination are basically the same, so the connection between student preferences and social choices can be ignored.

One theoretical basis of this research is derived from the basic concept of "Man struggles upwards" in traditional Chinese culture to explore new university ranking. The basic assumption is that universities are in a generally stable political and ecological environment. In countries and regions currently in conflicts of war, extreme religious conflicts, or extreme climates, the flow of academic talents is usually more restricted by other nonacademic factors, which may lead to a decline in the scientific level of university rankings based on academic mobility.

Another assumption is that there is a relatively complete global academic labor market and a country's academic labor market in which academic talents can flow freely, but generally speaking, some countries may still have government supervision and control over the flow of academic talents for various purposes. Take China as an example; in recent years, in order to curb the flow of academic talents from the west to the east, the Chinese government has introduced a large number of policies and measures to try to restrict the flow of scholars who have received specific honors. However,this part of the flow restriction is enhanced when the students graduated from school and become academic faculties, and the object of this research is the first employment behavior of the academic talent after graduation, which is usually subject to less government intervention.

Therefore, this study will explain the student's choices of schools from the perspective of cost benefit. Based on the

purpose of rational choice theory, the following formula explains the specific conditions for the emergence of rational choice theory:

$$V = BP - P'C. \quad (1)$$

If $V_i > V_j$, then V_i is chosen.

B represents the expected benefit, that is, the actor's expectation of the possible income of choice; C represents the expected cost, that is, the subjective judgment of the actor's cost of taking human and material resources for taking action; P and P', respectively, represent subjective judgments of the actor's likelihood of expected benefits and expected costs; V represents the net profit that the actor's choice may bring; and i and j represent different options.

When using this formula to analyze students' choices of schools, students' choices for further studies have a fixed scope. Because of differences in cultural capital, social capital, and economic capital of different students, each student's optimal solution V_i and opportunity cost V_j are not the same. Under the assumption of rational people, students will choose the one with the highest net benefit, the best choice. Therefore, the selected colleges can be considered as the most attractive colleges for the students, which is why we use the net flow of talents as the basis for calculating the "winning and losing" relationship.

Hypothesis: students tend to choose institutions with better teaching quality when they enter into the next education stage, and students are free to move

3.1. The Stage of Undergraduates. Let a be the number of schools used to compare the winning and losing relationship. Taking school i as an example, calculate the "winning and losing" relationship of i school (W_i). The number of undergraduate students in i school who go to j school to study for a master's degree is x_{ij}. The number of undergraduate students who are enrolled in j school but go to the i school to study for a master's degree is $x_{ji.}$ Then, $W_{ij} = x_{ij} - x_{ji}$ is the winning and losing relationship between the i school and the j school (in terms of the number of students), $i, j = 1, 2, 3, \ldots, a$.

Then, the comprehensive winning and losing relationship of i school is

$$W_i = \sum_{j=1}^{a} W_{ij} = \sum_{j=1}^{a} x_{ji} - x_{ij}. \quad (2)$$

Description of W_{ij}:

$W_{ij} > 0$, i school net victory (that is, i school is a university with a net inflow of talents)

$W_{ij} = 0$, i school and j school are of the same level

$W_{ij} < 0$, i_{school} net loss, i school is a university with a net outflow of talents

Compare $W_1, W_2, W_3, \ldots W_a$

The ranking rule is as follows:

If $W_1 > W_2 > W_3 > \ldots > W_a$, then $R_1 = 1$, $R_2 = 2$, $R_3 = 3$, $\ldots$, $R_a = a$ (R_i is the school ranking, $i = 1, 2, 3, \ldots, a$)

As shown in Figure 1, taking i school as an example, it shows the process of its winning and losing relationship.

3.2. The Stage of Postgraduates. Let a be the number of schools used to compare the winning and losing relationship. Taking school i as an example, calculate the "winning and losing" relationship of i school (I_i). The number of graduate students in i school who go to j school to study for a doctor's degree is y_{ij}. The number of doctoral students who are enrolled in j school but go to the i school to study for a doctor's degree is y_{ji}, and I_{ij} is the winning and losing relationship between the i school and the j school (in terms of the number of students), $i, j = 1, 2, 3, \ldots, a$.

Then, the comprehensive winning and losing relationship of i school is

$$I_i = \sum_{j=1}^{a} I_{ij} = \sum_{j=1}^{a} Y_{ji} - Y_{ij}. \quad (3)$$

Description of I_{ij}:

$I_{ij} > 0$, i school net victory

$I_{ij} = 0$, i school and j school are of the same level

$I_{ij} < 0$, i school net loss

Compare $I_1, I_2, I_3, \ldots I_a$

The ranking rule is as follows:

If $I_1 > I_2 > I_3 > \ldots > I_a$, then $R_1 = 1$, $R_2 = 2$, $R_3 = 3$, $\ldots$, $R_a = a$ (R_i is the school ranking, $i = 1, 2, 3, \ldots, a$)

3.3. The Stage of the Employment of Doctoral Students. Let a be the number of schools used to compare the "winning and losing" relationship. Taking school i as an example, calculate the "winning and losing" relationship of i school (E_i). The number of doctoral students in i school who go to j school to work is z_{ij}. The number of doctoral students who are enrolled in j school but go to the i school to work is z_{ji}, and E_{ij} is the "winning and losing" relationship between the i school and the j school (in terms of the number of students), $i, j = 1, 2, 3, \ldots, a$.

Then, the comprehensive winning and losing relationship of i school is

$$E_i = \sum_{j=1}^{a} E_{ij} = \sum_{j=1}^{a} z_{ij} - z_{ij}. \quad (4)$$

Description of E_{ij}:

$E_{ij} > 0$, i school net victory (that is, i school is a university with a net inflow of talents)

$E_{ij} = 0$, i school and j school are of the same level

$E_{ij} < 0$, i school net loss, i school is a university with a net outflow of talents

Compare $E_1, E_2, E_3, \ldots, E_a$

The ranking rule is as follows:

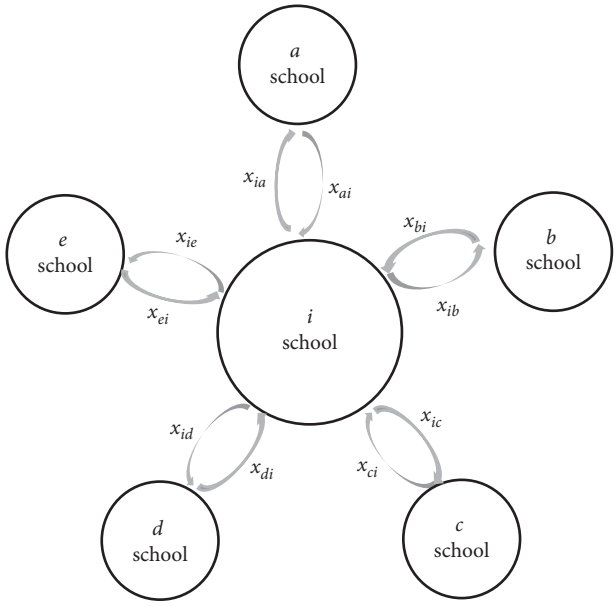

Figure 1: Talent mobility diagram.

If $E_1 > E_2 > E_3 > \ldots > E_a$, then $R_1 = 1$, $R_2 = 2$, $R_3 = 3$, ..., $R_a = a$ (R_i is the school ranking, $i = 1, 2, 3, \ldots, a$)

4. Data Collection

We collect the resumes of the faculties of the universities in the BRI countries, using Python language. Specifically, the main indicators selected by the winning and losing relationship approach are the attractiveness of further studies and employment competitiveness. The attraction of the study and employment competitiveness represent the level of recognition and recognition of students in colleges. According to the theory of rational choice, students tend to choose institutions that are most beneficial to them. Therefore, the attractive indicators can reflect the educational performance and industry reputation of the university to a certain extent so that they can be used as the basis for ranking.

In the analysis section of this paper, we mainly select the data from the universities in the BRI countries to implement the above methodology. The BRI is the first two-multilateral mechanism that China has proposed to rely on China and related countries and, at the same time, leverage existing cooperation resources to establish an effective regional cooperation platform [53, 54]. The platform aims to use the historical symbols of the ancient Silk Road to actively develop economic partnerships with countries along the line from the formation of political mutual trust, economic integration, culturally inclusive community of interests, a community of destiny, and a community of responsibility [55, 56]. As global strategic cooperation, higher education research in countries along the BRI has gradually gained great attention in recent years [57]. Cooperation in education has also led to an increase in the level of higher education in the BRI countries. However, most universities along the BRI countries are difficult to rank in the mainstream rankings. The BRI countries have performed poorly on the global university rankings, and there are characteristics of "less quantity" and "quality difference." Not only the number of countries on the list and the top 500 universities in the list are small but also the ranked universities are ranked lower. There are internal and external factors in this phenomenon. The internal aspect is that most countries, along with the BRI countries, still have a certain gap between higher education and developed countries due to their economic and social development level. Therefore, the overall strength and international competitiveness of universities along the BRI countries are not strong. The external reasons are mainly reflected in the fact that the existing mainstream universities basically have some institutions in developed countries to carry out ranking work. The ranking index system formulated by these institutions is compatible with the mainstream development direction education system of universities in developed countries. The focus of such systems is different from the development trend and current situation of universities in the countries along the BRI, which may also affect their ranking results. Therefore, the universities in the countries along the BRI need a ranking system which is more suitable for their actual development, and the "winning and losing" relationship method is an effective solution to solve this problem.

Based on the above theory and practice, we collected the resumes of more than 20,000 faculties from 286 universities or higher education institutions in 35 BRI countries from the official website of the universities (the resumes of faculties not published on the official website of the university are not included) by Python and descendant collector. There are only 4 English-speaking countries among the 64 countries along the "Belt and Road." There are indeed problems such as slow update of websites in non-English-speaking countries and missing resumes of a few young scholars. However, 4 English-speaking countries also have problems with lagging resumes. And because the original data come from the official websites of higher education institutions in countries along the "Belt and Road," some schools' official websites have missing data, and the number of "Belt and Road" countries is increasing every year, so the study does not include all the countries along the "Belt and Road."

The distribution of institutions is presented in Table 1.

5. Model Results

We extract information about undergraduate, postgraduate, and doctoral programs of universities in the BRI countries. We then apply our methodology using MATLAB to calculate the "winning and losing" relationship of each university or higher education institution. The results are reported in the following.

5.1. The Attraction for Undergraduates to Continue Their Studies. Table 2 presents the ranking of the top 10 universities in terms of attractiveness for undergraduates to continue their studies. From the BRI universities we surveyed, the gap between the "winning and losing"

Table 1: The distribution of universities across countries.

Countries	The number of universities
Bangladesh	31
India	27
Bulgaria	24
Greece	20
Cyprus	18
Indonesia	16
Romania	14
Pakistan	13
Czech Republic	13
Russia	11
Malaysia	11
Azerbaijan	8
Croatia	8
Armenia	8
Albania	7
Bahrain	5
Philippines	5
Iran	5
Egypt	4
Poland	4
Georgia	4
Cambodia	4
Jordan	4
Turkey	3
Ukraine	3
Iraq	3
Vietnam	3
Afghanistan	2
Lithuania	2
Macedonia	2
Lebanon	1
Saudi Arabia	1
Uzbekistan	1
Yemen	1
Montenegro	1

relationships between universities is not very large. In terms of the attractiveness of undergraduate progression, the best-performing institution is the University of Bahrain from Bahrain, with a net inflow of talent of 4. The worst-performing institution is Beni-Suef University from Egypt, with a net outflow of talent of 8. There is only a difference of 12 units of measure between the net inflows of talent in these two institutions. Among the 286 colleges and universities, only 11 colleges and universities belong to the net inflow of talents, accounting for 3.8% of all ranked universities. Only 12 colleges and universities belong to the net outflow of talents, accounting for 4.2%. The other 264 colleges and universities are basically the same in terms of the number of inflows and inflows of higher education talents, accounting for 92%. This shows that most of the universities in the BRI countries have little difference in the attractiveness of postgraduate studies, and they have no outstanding influence.

According to the "winning and losing" relationship approach, the University of Bahrain, Nahda University, North South University, and the University of Cyprus are more attractive to undergraduates. Among the top 10 universities, four universities are from Bangladesh, and others are from Bahrain, Egypt, Cyprus, Pakistan, Ukraine, and the Czech Republic. This phenomenon shows that there are specific differences in the attractiveness of undergraduate students in different countries, along with the BRI countries.

Table 3 and Figure 2 present the distribution of net talent flows of undergraduates. Of the 12 universities with a net outflow of talents, three are from India, two are from Bahrain, and two are from Cyprus. Other institutions are from the Czech Republic, Iran, Malaysia, Georgia, and Egypt.

The rankings of colleges and universities calculated by this method essentially reflect the relatively balanced attraction of undergraduate students in most BRI countries, and only a few universities are more prominent. Such a result may be due to the fact that most of the BRI countries are developing countries, and the level of education development is not high. Many countries concentrate limited educational resources on one or several key universities, leading to general education in ordinary universities. Therefore, these colleges are not attractive. Many schools have a low turnover of talents. It is also possible that many students in the BRI universities cannot enter higher universities for further study due to information asymmetry, narrow channels for further studies, and high barriers to entry. Information asymmetry is mainly reflected in the significant cultural and linguistic diversity of the BRI countries. Therefore, in the internationalization of talent mobility, many students may not be able to obtain information about universities in other countries because of language and cultural barriers. The narrowing of the channels for further studies and the high threshold for progression are reflected in the fact that many students in the BRI universities are mainly oriented to elite groups because of their insufficient economic and social development, limited educational resources, and information asymmetry. These factors, in fact, have affected the undergraduate students' further study choices.

As for the difference in net talent inflows between institutions in different countries, there are two different interpretation angles. The first is that the countries along the BRI have both developed and developing countries. In essence, the level of economic and social development between countries is quite different. Therefore, institutions from countries with a high degree of economic and social development may have greater advantages in the level of higher education and the attractiveness of further studies. The other angle is that the BRI countries have large differences in language and culture, and students tend to move within a certain area. Therefore, the geofigureical factors, that is, the degree of active talent flow in the region, will also affect the degree to a certain extent. Thus, the scores of the "winning and losing" relationship of regional universities can show differences in rankings of universities.

5.2. The Attraction for Postgraduate Studies. In terms of the attractiveness of postgraduates, the absolute gap between the universities is unchanged. The flow of talents in the

Table 2: The ranking of the attractiveness for undergraduates to continue their studies (top 10).

University	Country	The net inflow of talents
University of Bahrain	Bahrain	4
Nahda University	Egypt	3
North South University	Bangladesh	3
University of Cyprus	Cyprus	2
Gomal University	Pakistan	1
Kharkiv National University of Radio Electronics	Ukraine	1
Masaryk University	Czech Republic	1
Northern University	Bangladesh	1
Shahjalal University of Science and Technology	Bangladesh	1
University of Dhaka	Bangladesh	1

Table 3: The distribution of net talent flows of undergraduates.

Net inflow	The number of universities
4	1
3	2
2	1
1	6
0	264
−1	11
−8	1

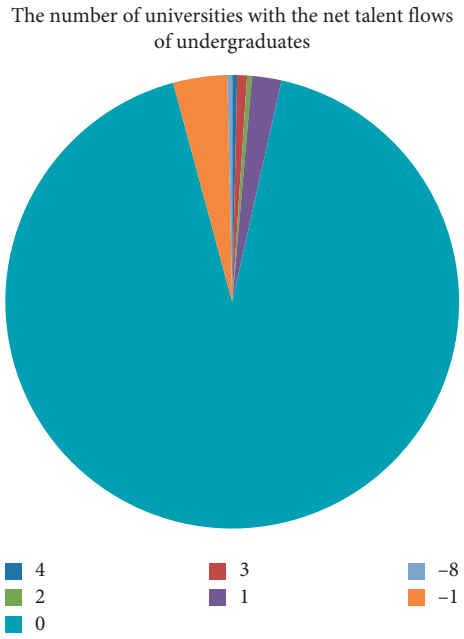

Figure 2: The distribution of net talent flows of undergraduates.

postgraduate period is still small, but the internal changes in the rankings are very obvious. The best and worst universities for the entry of graduate students are from Azerbaijan. As presented in Table 4, the best-performing university is Baku State University, with a net inflow of 6. Table 4 shows the top ten colleges and universities in terms of the attractiveness of graduate students using the winning and losing relationship method. Among the ten universities, three universities are from Bangladesh, and two are from Pakistan; other universities are from Azerbaijan, Bahrain, Egypt, India, and Cyprus, respectively.

Table 5 and Figure 3 present the distribution of the net talent flows of postgraduates. Among the 23 institutions with a net outflow of talent, seven are from India, accounting for 30.4% of all net outflows of colleges and universities, with the highest proportion. Three are from Pakistan, two from Bahrain, two from Malaysia, and two from Cyprus, and other institutions are from the Czech Republic, Iran, Bangladesh, Georgia, Egypt, Romania, and Azerbaijan. The worst performer is Khazar University, whose net inflow of talent is −6. Compared with the undergraduate entrance degree, the absolute difference between the best and the worst institutions is the same, but the structure of the whole ranking has changed a lot. The number of institutions with a net inflow of talents has changed from 11 to 19, accounting for 6.7%. The number of colleges with a net outflow of talents has changed from 12 to 23, accounting for 8%. The number of universities with basically the same level of talent inflows and outflows decreases from 264 to 244, accounting for 85.3%. It explains that, to a certain extent, in the postgraduate entrance examination stage, the number of institutions with basically the same level of talent inflow and outflow is decreasing, indicating that some institutions have changed from a college with a flat flow of talents to a net inflow of talents or a net outflow. There are certain differences in the attractiveness of undergraduate and postgraduate students within each university, and the mobility of talents is also increasing.

The result shows that, during the master's degree, the educational performance of the BRI universities has changed significantly. The higher education stage needs more abundant educational resources to support, and the distribution of educational resources makes the overall performance of colleges and universities and the attractiveness of further studies appear to be different, which makes the discrimination between universities increase. Although the absolute gap has not changed, most students generally prefer colleges with better teaching level in the choice of colleges. Therefore, the reduction of colleges with more balanced talents indicates that the mobility of talents between universities is higher. This may be due to the fact that there are fewer talents who tend to continue to pursue academic

Table 4: The ranking of the attractiveness for postgraduate studies (top 10).

University	Country	The net inflow of talents
Baku State University	Azerbaijan	6
University of Bahrain	Bangladesh	6
Nahda University	Egypt	3
North South University	Bangladesh	3
Rajshahi University	Bangladesh	3
University of Dhaka	Bangladesh	3
Aligarh Muslim University	India	2
Gomal University	Pakistan	2
Institute of Business Administration	Pakistan	2
University of Cyprus	Cyprus	2

Table 5: The distribution of net talent flows of postgraduates.

Net inflow	The number of universities
6	2
3	4
2	4
1	9
0	244
−1	15
−2	5
−4	1
−6	2

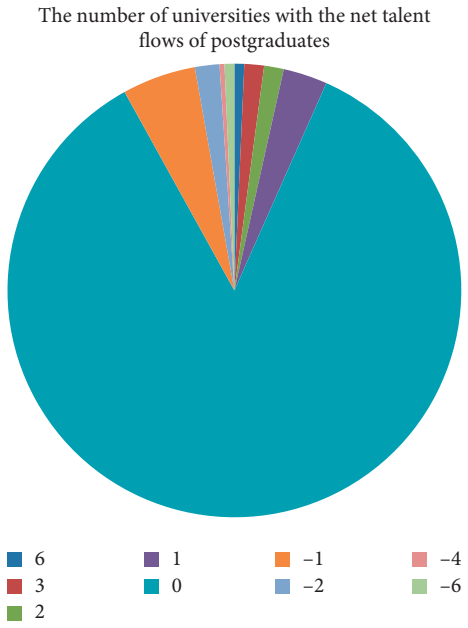

Figure 3: The distribution of net talent flows of postgraduates.

research at the doctoral level compared to the postgraduate level. These people are more likely to concentrate on stronger institutions and lead to more frequent talent flows.

5.3. The Attraction for Doctoral Students. Table 6 presents the ranking of the top ten universities in terms of attraction to doctoral students. Among the ten institutions, two institutions are from India, and other institutions are from

Table 6: The ranking of the attraction of doctoral students (top 10).

University	Country	The net inflow of talents
Anna University	India	37
University of Dhaka	Bangladesh	24
Aligarh Muslim University	India	17
Yerevan State University	Armenia	17
Baku State University	Azerbaijan	14
University of Zagreb	Croatia	14
University of Athens	Greece	14
University of Georgia	Georgia	13
Beni-Suef University	Egypt	12
University of Malaya	Malaysia	12

Bangladesh, Armenia, Azerbaijan, Croatia, Greece, Georgia, Egypt, and Malaysia. The country diversity of the top ten institutions in the employment competitiveness of doctoral students has increased compared with the previous two lists, which also shows that the mobility of talents in the doctoral degree is further enhanced. Of the ten institutions with the largest net outflow of talent, three are from India, and the other institutions are from Croatia, Romania, Egypt, Azerbaijan, Armenia, Pakistan, and Indonesia.

Table 7 and Figure 4 present the distribution of net talent flows of doctoral students.

As shown in Table 7, at the doctoral level, the mobility of talents has been further enhanced, and the absolute gap between universities expands. Compared with the attractiveness of undergraduate and postgraduate students, the absolute gap in the number of graduates' employment competitiveness rankings has further widened, from 12 to 112, with a large difference. The number of universities with a net inflow of talents has changed from 19 in the master's degree to 33, accounting for 11.5%. The number of universities with a net outflow of talents changes from 22 in the master's degree to 97, accounting for 34%, which is a significant increase compared with the undergraduate and postgraduate rankings. There are 156 institutions with equal inflows and outflows, accounting for 54.5%. Among the universities we surveyed, the best-performing institution for the employment attractiveness of doctoral students is Anna University from India, with a net inflow of talents of 37; the worst-performing institution is Airlangga University from Indonesia, with a net inflow of talent of −75. It not only shows that the gap in the employment attractiveness of

Table 7: The distribution of net talent flows of doctoral students.

Net inflow	The number of universities
37	1
24	1
17	2
14	3
13	1
12	2
11	1
9	1
8	1
6	1
5	1
4	3
3	4
2	5
1	6
0	156
−1	35
−2	23
−3	10
−4	5
−5	4
−6	3
−7	4
−8	2
−9	2
−11	1
−12	1
−13	2
−14	1
−20	1
−21	1
−52	1
−75	1

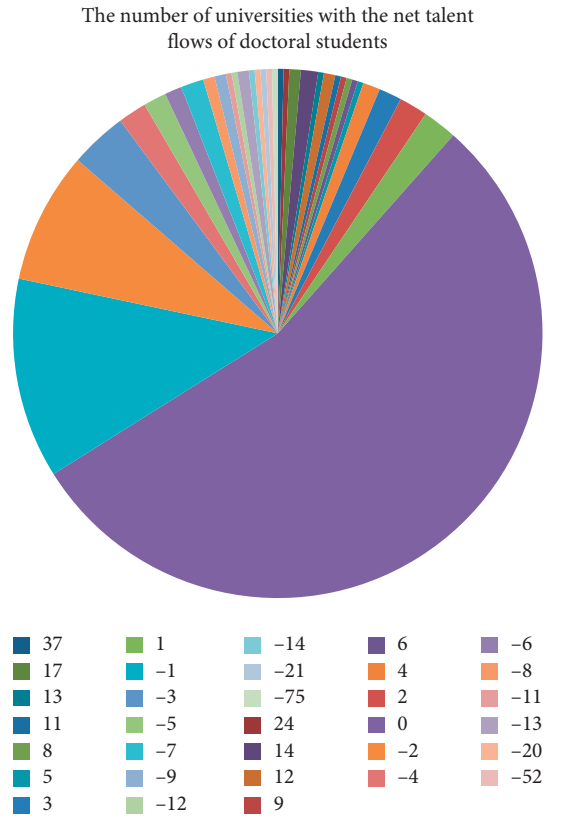

Figure 4: The distribution of net talent flows of doctoral students.

doctoral students in colleges and universities is relatively large but also shows that many doctoral students in the BRI universities are more concentrated in a certain number of universities after graduation. Therefore, a small number of universities have much higher competitiveness and attractiveness than other colleges and universities, so more graduate students tend to go to such colleges and universities. For example, Nahda University has performed well in the undergraduate and postgraduate progression competitiveness rankings, but it has a net outflow of talents in the doctoral degree, which affects the overall education level of the school.

In addition to the difference in the quality of education between universities in the postgraduate degree, this difference also reflects the disconnection of higher education at all levels in higher education, that is, the level of education at all levels has significant differences. Many colleges and universities have different performances at different levels of higher education. The large fluctuations in the attractiveness of higher education or employment also reflect the differences in education levels. For example, Anna University has a net outflow of talents for undergraduate and postgraduate students. However, in the employment competitiveness of doctoral students, it has become the university with the largest net inflow of talents. One of the reasons is due to different educational priorities of different universities, such as the difference in the importance of academic research and student training and the diversity of teaching quality requirements at different levels of higher education lead to large differences in the quality of education at all levels. The second reason is that due to the economic and social development level of the BRI countries, the academic research resources are limited, and the distribution of scientific research resources has led to great differences in the scientific research performance of universities. The employment trend of doctoral students is more concentrated in some universities with strong academic research strength, which leads to the high frequency of doctoral students. The third is that employment is different from that of further studies. In addition to the teaching level, the employment choices for doctoral students are also affected by salary and academic research. The influence of this type of factor does not exist in the ranking of the attractiveness of the study, so the role of more factors may also be the reason for the difference between the doctoral student's mobile ranking and the first two rankings.

6. Discussion and Conclusion

Based on the above ranking results of the BRI universities, we propose three major conclusions.

First, at the undergraduate and postgraduate levels, the talent mobility preferences of the universities are not

obvious, and the absolute difference between the "winning and losing" relationship is small. It shows that, in the cognition of students, the gap in attractiveness between universities is not large. The concentration of student choice is low, and there is no university that shows outstanding advantages in the ranking of these two stages.

Second, from the rankings of undergraduates to doctoral students based on the "winning and losing" relationship, the actual gap score between universities is constantly expanding; especially, in the attraction of doctoral students, the gap is particularly prominent.

Third, at different stages of education, the attraction of certain universities varies greatly between universities. Some universities even change from a net inflow at the undergraduate stage to a net outflow at the doctoral students' stage.

All in all, the rankings based on the "winning and losing" relationship are somewhat different from the existing mainstream ranking results, indicating that the existing rankings include factors other than the quality of teaching in the evaluation indicators. In fact, this makes the stakeholders' understanding of the teaching level of each university have a great deviation from the actual situation. Among them, the most similar to the existing university ranking results are the results of the employment attraction ranking of doctoral students, indicating that the existing university ranking method with the status of scientific research as the main measure can reflect the quality of education in the doctoral degree to a certain extent. The requirements for higher education for doctoral students are mainly reflected in academic research. Therefore, this ranking is similar to some mainstream rankings based on scientific research. In the undergraduate and postgraduate stages, the main emphasis is on the level of teaching. This may be the reason why the "winning and losing" relationship rankings in these two stages are different from the mainstream ranking results.

This paper, for the first time, systematically evaluates and ranks universities in the BRI countries. By introducing a new method of university ranking based on complex system models, we contribute to the complex system research and university ranking research, respectively. By applying the new method of university ranking in the BRI countries, we contribute to the BRI research.

We apply the "winning and losing" relationship ranking method to 286 universities in 35 BRI countries. We find that the gap in the scores of the "winning and losing" of universities is constantly increasing with the improvement of higher education in these countries. At the undergraduate and postgraduate levels, the scores of the "winning and losing" relationship of the universities are not much different, but there is a big difference in the employment stage of doctoral students. At the same time, there are certain differences in the scores of the "winning and losing" relationship between different universities at different levels of higher education. Current major university rankings lack robust results, sometimes even produce controversial results [58–62]. Our research answers the call for solid methodology and objective measurements in the university ranking field [29, 37, 61].

Moreover, with the continuous development of higher education, the free flow of higher education talents is becoming more and more frequent, and its globalization trend is deepening [63, 64]. University rankings are playing an increasingly important role as an important reference for talents and educational mobility. In recent years, the attention and influence of university rankings in both higher education and social life are rising. However, there are still many problems in the current mainstream university rankings, especially in measuring the quality of education [29, 38]. This paper proposes a new method based on students' choice behaviors of colleges to measure the attraction and competitiveness of colleges and universities, thus demonstrating the level of college education, that is, the method of the "winning and losing" relationship. This approach complements the existing mainstream ranking gap. This method can innovatively provide stakeholders with reference and guidance for decision-making and improve the validity and accuracy of university rankings.

In conclusion, through the above research conducted by the "winning and losing" relationship method, this paper quantifies the metrics of university rankings and applies the method in universities in the BRI countries. Our research offers an alternative reference for students' school choice and can also guide policymakers to make interuniversity collaboration policies and decisions. Future research can use our research as a starting point to study the relative status and competitiveness between universities in the BRI countries.

Data Availability

The data used to support the findings of this study have not been made available because they are collected by our research group with a lot of manpower, material, and financial resources. Now sharing the data will affect the subsequent publication.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

References

[1] P. Taylor and R. Braddock, "International university ranking systems and the idea of university excellence," *Journal of Higher Education Policy and Management*, vol. 29, no. 3, pp. 245–260, 2007.

[2] M. P. Çakır, C. Acartürk, O. Alaşehir et al., "A comparative analysis of global and national university ranking systems," *Scientometrics*, vol. 103, no. 3, pp. 813–848, 2015.

[3] M. Saisana, B. d'Hombres, and A. Saltelli, "Rickety numbers: volatility of university rankings and policy implications," *Research Policy*, vol. 40, no. 1, pp. 165–177, 2011.

[4] F. Koenings, G. Di Meo, and S. Uebelmesser, "University rankings as information source: do they play a different role for domestic and international students?" *Applied Economics*, vol. 52, no. 59, pp. 6432–6447, 2020.

[5] A. Winkelbach and A. Walter, "Complex technological knowledge and value creation in science-to-industry

technology transfer projects: the moderating effect of absorptive capacity," *Industrial Marketing Management*, vol. 47, pp. 98–108, 2015.

[6] L. Leydesdorff and M. Meyer, "Triple helix indicators of knowledge-based innovation systems," *Research Policy*, vol. 35, no. 10, pp. 1441–1449, 2006.

[7] I. A. Ivanova and L. Leydesdorff, "Rotational symmetry and the transformation of innovation systems in a triple helix of university-industry-government relations," *Technological Forecasting and Social Change*, vol. 86, pp. 143–156, 2014.

[8] F. Wei and X. Limin, "Simulation of knowledge transfer process model between universities: a perspective of cluster innovation network," *Complexity*, vol. 2018, Article ID 5983531, 13 pages, 2018.

[9] Yi Su and T. Li, "Simulation analysis of knowledge transfer in a knowledge alliance based on a circular surface radiator model," *Complexity*, vol. 2020, Article ID 4301489, 27 pages, 2020.

[10] K. A. H. Kobbacy and D. N. P. Murthy, *Complex System Maintenance Handbook*, Springer-Verlag London Ltd, London, UK, 2008.

[11] W. B. Arthur, S. N. Durlauf, and D. A. Lane, *The Economy as an Evolving Complex System II*, CRC Press, Boca Raton, FL, USA, 2018.

[12] W. B. Arthur, "Complexity and the economy," *Science*, vol. 284, no. 5411, pp. 107–109, 1999.

[13] I. A. Ivanova and L. Leydesdorff, "Knowledge-generating efficiency in innovation systems: the acceleration of technological paradigm changes with increasing complexity," *Technological Forecasting and Social Change*, vol. 96, pp. 254–265, 2015.

[14] Y. Su and Y.-q. Yu, "Spatial agglomeration of new energy industries on the performance of regional pollution control through spatial econometric analysis," *Science of The Total Environment*, vol. 704, Article ID 135261, 2020.

[15] R. M. May, "Will a large complex system be stable?" *Nature*, vol. 238, no. 5364, pp. 413-414, 1972.

[16] J. Ladyman, J. Lambert, and K. Wiesner, "What is a complex system?" *European Journal for Philosophy of Science*, vol. 3, no. 1, pp. 33–67, 2013.

[17] S. Liu, "Can ranking contribute to the quality assurance of higher education? an examination of the Chinese disciplinary ranking," *Cambridge Journal of Education*, pp. 1–19, 2020.

[18] University consortium of maritime silk road launched in Xiamen, 2020, https://eng.yidaiyilu.gov.cn/qwyw/rdxw/69333.htm.

[19] M. Dobrota, M. Bulajic, L. Bornmann, and V. Jeremic, "A new approach to the QS university ranking using the composite i-distance indicator: uncertainty and sensitivity analyses," *Journal of the Association for Information Science and Technology*, vol. 67, no. 1, pp. 200–211, 2016.

[20] D. D. Dill and M. Soo, "Academic quality, league tables, and public policy: a cross-national analysis of university ranking systems," *Higher Education*, vol. 49, no. 4, pp. 495–533, 2005.

[21] M.-H. Huang, "Opening the black box of QS world university rankings," *Research Evaluation*, vol. 21, no. 1, pp. 71–78, 2012.

[22] C. Springer, G. Doğan, and U. Al, "Is it possible to rank universities using fewer indicators? a study on five international university rankings," *Aslib Journal of Information Management*, vol. 71, 2019.

[23] S. Balasubramanian, Y. Yang, and S. Tello, "Does university entrepreneurial orientation matter? evidence from university performance," *Strategic Entrepreneurship Journal*, vol. 14, 2020.

[24] T. Luque-Martínez and N. Faraoni, "Meta-ranking to position world universities," *Studies in Higher Education*, vol. 45, no. 4, pp. 819–833, 2020.

[25] Y. Zhang, Y. Xiao, J. Wu, and X. Lu, "Comprehensive world university ranking based on ranking aggregation," *Computational Statistics*, pp. 1–14, 2020.

[26] World University Rankings, *World University Rankings 2019: Methodology*, World University Rankings, Oxford, UK, 2019.

[27] V. Safón, "Inter-ranking reputational effects: an analysis of the academic ranking of world universities (ARWU) and the times higher education world university rankings (THE) reputational relationship," *Scientometrics*, vol. 121, no. 2, pp. 897–915, 2019.

[28] H. F. Moed, "A critical comparative analysis of five world university rankings," *Scientometrics*, vol. 110, no. 2, pp. 967–990, 2017.

[29] F. A. Massucci and D. Docampo, "Measuring the academic reputation through citation networks via pagerank," *Journal of Informetrics*, vol. 13, no. 1, pp. 185–201, 2019.

[30] M. Benito, P. Gil, and R. Romera, "Funding, is it key for standing out in the university rankings?" *Scientometrics*, vol. 121, no. 2, pp. 771–792, 2019.

[31] L. Bornmann, R. Mutz, and H.-D. Daniel, "Multilevel-statistical reformulation of citation-based university rankings: the leiden ranking 2011/2012," *Journal of the American Society for Information Science and Technology*, vol. 64, no. 8, pp. 1649–1658, 2013.

[32] L. Waltman, C. Calero-Medina, J. Kosten et al., "The leiden ranking 2011/2012: data collection, indicators, and interpretation," *Journal of the American Society for Information Science and Technology*, vol. 63, no. 12, pp. 2419–2432, 2012.

[33] M. N. Hossain and S. Z. Ahmed, "Use of scholarly communication and citation-based metrics as a basis for university ranking in developing country perspective," *Global Knowledge, Memory and Communication*, vol. 69, 2020.

[34] N. Robinson-Garcia, D. Torres-Salinas, E. Herrera-Viedma, and D. Docampo, "Mining university rankings: publication output and citation impact as their basis," *Research Evaluation*, vol. 28, no. 3, pp. 232–240, 2019.

[35] Á. Török and A. M. Nagy, "China: a candidate for winner in the international game of higher education?" *Acta Oeconomica*, vol. 70, no. S, pp. 127–152, 2020.

[36] S. Chatelain-Ponroy, S. Mignot-Gérard, C. Musselin, and S. Sponem, "Is commitment to performance-based management compatible with commitment to university "publicness"? academics' values in French universities," *Organization Studies*, vol. 39, no. 10, pp. 1377–1401, 2018.

[37] M. Hosier and B. K. A. Hoolash, "The effect of methodological variations on university rankings and associated decision-making and policy," *Studies in Higher Education*, vol. 44, no. 1, pp. 201–214, 2019.

[38] K. Soh, "The seven deadly sins of world university ranking: a summary from several papers," *Journal of Higher Education Policy and Management*, vol. 39, no. 1, pp. 104–115, 2017.

[39] R. Lukman, D. Krajnc, and P. Glavič, "University ranking using research, educational and environmental indicators," *Journal of Cleaner Production*, vol. 18, no. 7, pp. 619–628, 2010.

[40] C. Guarino, G. Ridgeway, M. Chun, and R. Buddin, "Latent variable analysis: a new approach to university ranking," *Higher Education in Europe*, vol. 30, no. 2, pp. 147–165, 2005.

[41] M. Hechter and S. Kanazawa, "Sociological rational choice theory," *Annual Review of Sociology*, vol. 23, no. 1, pp. 191–214, 1997.
[42] R. Boudon, "Beyond rational choice theory," *Annual Review of Sociology*, vol. 29, no. 1, pp. 1–21, 2003.
[43] J. Luo, "The power-of-pull of economic sectors: a complex network analysis," *Complexity*, vol. 18, no. 5, pp. 37–47, 2013.
[44] S. Moser, "Orderings based on the banks set: some new scoring methods for multicriteria decision making," *Complexity*, vol. 20, no. 5, 2015.
[45] B. E. Ashforth and F. Mael, "Social identity theory and the organization," *The Academy of Management Review*, vol. 14, no. 1, pp. 20–39, 1989.
[46] M. Hudik, "Two interpretations of the rational choice theory and the relevance of behavioral critique," *Rationality and Society*, vol. 31, no. 4, pp. 464–489, 2019.
[47] A. Juarrero, *Dynamics in Action: Intentional Behavior as a Complex System*, Emergence, Marin County, CA, USA, 2000.
[48] D. J. Watts and S. H. Strogatz, "Collective dynamics of "small-world" networks," *Nature*, vol. 393, no. 6684, pp. 440–442, 1998.
[49] C. Del-Castillo-Feito, A. Blanco-González, González-Vázquez, and Encarnación, "The relationship between image and reputation in the Spanish public university," *European Research on Management & Business Economics*, vol. 25, 2019.
[50] A. Bouchet, M. D. Laird, M. Troilo, M. Hutchinson, and G. Ferris, "Effects of increased commitment on reputation and status: evidence from ncaa division i universities," *Sport Management Review*, vol. 20, 2017.
[51] C. Chen and M. O. Esangbedo, "Evaluating university reputation based on integral linear programming with grey possibility," *Mathematical Problems in Engineering*, vol. 2018, Article ID 5484326, 17 pages, 2018.
[52] P. Foroudi, Q. Yu, S. Gupta, and M. M. Foroudi, "Enhancing university brand image and reputation through customer value co-creation behaviour," *Technological Forecasting and Social Change*, vol. 138, 2018.
[53] F. Zhai, "China's belt and road initiative: a preliminary quantitative assessment," *Journal of Asian Economics*, vol. 55, pp. 84–92, 2018.
[54] Y. Huang, "Understanding China's belt & road initiative: motivation, framework and assessment," *China Economic Review*, vol. 40, pp. 314–321, 2016.
[55] N. Rolland, "China's "belt and road initiative": underwhelming or game-changer?" *The Washington Quarterly*, vol. 40, no. 1, pp. 127–142, 2017.
[56] W. Liu and M. Dunford, "Inclusive globalization: unpacking China's belt and road initiative," *Area Development and Policy*, vol. 1, no. 3, pp. 323–340, 2016.
[57] W. Zhou and M. Esteban, "Beyond balancing: China's approach towards the belt and road initiative," *Journal of Contemporary China*, vol. 27, no. 112, pp. 487–501, 2018.
[58] J. P. A. Ioannidis, N. A. Patsopoulos, F. K. Kavvoura et al., "International ranking systems for universities and institutions: a critical appraisal," *BMC Medicine*, vol. 5, no. 1, p. 30, 2007.
[59] S. S. Amsler and C. Bolsmann, "University ranking as social exclusion," *British Journal of Sociology of Education*, vol. 33, no. 2, pp. 283–301, 2012.
[60] R. Grewal, J. A. Dearden, and G. L. Llilien, "The university rankings game," *The American Statistician*, vol. 62, no. 3, pp. 232–237, 2008.
[61] D. Docampo, "On using the Shanghai ranking to assess the research performance of university systems," *Scientometrics*, vol. 86, no. 1, pp. 77–92, 2011.
[62] J. Sadlak and N. C. Liu, *The World-Class University and Ranking: Aiming beyond Status*, Unesco-Cepes, Bucharest, Romania, 2007.
[63] S. Choi, "Globalization, China's drive for world-class universities (211 project) and the challenges of ethnic minority higher education: the case of yanbian university," *Asia Pacific Education Review*, vol. 11, no. 2, pp. 169–178, 2010.
[64] A. Geuna and L. J. J. Nesta, "University patenting and its effects on academic research: the emerging European evidence," *Research Policy*, vol. 35, no. 6, pp. 790–807, 2006.