Relationship between the international universities rankings and indexes of a country's innovation development

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Abstract. Currently, the global economy is experiencing a global innovation gap, representing a set of significant disparities in the innovative development of individual countries. The global innovation gap is a consequence of a number of objective phenomena and processes taking place in different countries and regions. The study of the nature of the innovation gap implies the study of specific problems in the innovative development of countries, as well as the search for ways to solve them. This article examines the relationship between the global innovation index and the positions of national universities in international rankings. We have chosen a group of countries (developed, developing and transition economies) and their universities which ranked best in international rankings. The sample consisted of 24 countries, the university's rating was chosen as the dependent variable, and the country's rating on the global innovation index was selected as an independent variable. After the calculations, the linear pair correlation coefficient was set equal to 0.913, which indicates a high level of coupling between the variables. The coefficient of determination indicates that in 83.35% of cases the changes in x lead to a change in y. In other words, the accuracy of selecting the regression equation is high. The remaining 16.65% change in Y is due to factors not taken into account in the model (as well as by specification errors). The conducted studies confirmed the connection between the quality of education, the research sector of universities and the level of innovative development of countries. This made it possible to propose a set of measures to strengthen the positions of national universities in international rankings and increase their contribution to the transition of the Russian economy to an innovative development path.

1. Introduction
The experience of the leading countries shows the strengthening of the contribution of universities to the development of innovation and economic growth. State financing of research in higher education institutions is increasingly oriented towards specific socio-economic goals and is dependent on the final results; the role of contract financing is growing. Although universities in OECD countries still carry out the bulk of fundamental research (up to 50% of the total amount of research and development in this sector), in a number of countries the share of industrial funding for university research is growing and points at 8-14% (Canada, Belgium, Hungary, Germany) and even 15-23% (Korea, Turkey). In China it reaches 37%. Innovative orientation of the activities of universities is also
provided through the training of qualified scientists and engineers and the increasing participation of teachers and graduate students in the implementation of research and development, the transfer of their results in industry [1]. In this article, the authors decided to identify the relationship between the rankings of universities and indexes of innovative development of countries.

2. The main part
The rankings of the best universities in the world are compiled annually by various agencies. The first of them was published in the journal "US News & World Report" in 1983. Later, they began to be formed by specialized agencies. Every ranking has its own methodology, so it is necessary to study its methodological base in order to correctly interpret the results [3].

One of the most respected rankings in the field of higher education is the Times Higher Education (THE). Its compilers are selected annually by the best universities in the world on the basis of the following indicators: the level of teaching, the quality of research activities and the volume of citations of research, innovation and the involvement of the university in global international processes. The authors of the rating pay special attention to financing and the income of higher education institutions as evidence of the effectiveness of their work and the quality of their material resources.

The first three indicators are the most significant and in aggregate constitute 67%. The largest share of them falls on the citation of scientific publications. The world publishes about 200,000 scientific journals, of which about 40,000 are rated, and 12,000 most popular journals in the scientific community are being used to form the citation indicators for rankings.

Leaders in the rating of THE are the United States and Great Britain. And if you follow the dynamics by years, namely from 2010 to 2016, you can see that the US is gradually losing its positions, as evidenced by the trend line as well as the drop of share in top-100 world universities from 2010 to 2016 by 12%; the share of the UK decreased by 2%; and the countries of South - East Asia improved their positions by 1 - 2%. Other countries show slight fluctuations (Figure 1). All changes in the scale reflect turbulent competitive processes, since all states tend to keep their positions in this rating. section we discuss how to format the title, authors and affiliations. Please follow these instructions as carefully as possible so all articles within a conference have the same style to the title page. This paragraph follows a section title so it should not be indented.
Also, one of the famous rankings is QS World University Rankings, compiled by the consulting company Quacquarelli Symonds. This organization positions itself as a guide in the international market of educational services. The first ranking was compiled in 2004 and since then QS has become one of the leading agencies in this field. In the scale of assessments of QS, the largest share is occupied by academic reputation, which is determined through a survey of scientists on the highest level of scientific research and one cannot vote for his university. The main advantage is a more objective evaluation in comparison with the citation index. The second indicator is based on the data of global surveys which determine the best universities in regard of producing the most trained specialists. The third indicator shows how well the universities are "provided" by teachers to ensure work in groups, i.e. maximum time for each student. The next three indicators (the citation index, the
share of foreign students and teachers) also play an important role in assessing the international status of the university.

Based on the analysis of the rankings with QS methodology, we identified the countries with more than 10 universities in the rankings for the period 2013-2016 (Table 1).

Table 1. Countries with 10 and more universities in QS World Universities rankings.

| Country    | 2013 | 2014 | 2015 | 2016 | Growth, %          | Basic | 2014/2013 | 2015/2014 | 2016/2015 |
|------------|------|------|------|------|--------------------|-------|-----------|-----------|-----------|
| Argentina  | 16   | 16   | 16   | 16   | 0,00               | 0,00  | 0,00      | 0,00      | 0,00      |
| Australia  | 31   | 33   | 33   | 35   | 12,90              | 6,45  | 0,00      | 0,00      | 6,06      |
| Brazil     | 22   | 22   | 22   | 22   | 0,00               | 0,00  | 0,00      | 0,00      | 0,00      |
| Canada     | 26   | 26   | 26   | 26   | 0,00               | 0,00  | 0,00      | 0,00      | 0,00      |
| Chile      | 9    | 11   | 11   | 11   | 22,22              | 22,22 | 0,00      | 0,00      | 0,00      |
| China      | 25   | 27   | 30   | 33   | 32,00              | 8,00  | 11,11     | 10,00     |
| Colombia   | 9    | 9    | 10   | 10   | 11,11              | 0,00  | 11,11     | 0,00      |
| Finland    | 9    | 9    | 9    | 10   | 11,11              | 0,00  | 0,00      | 11,11     |
| France     | 40   | 41   | 41   | 39   | -2,50              | 2,50  | 0,00      | -4,88     |
| Germany    | 42   | 42   | 43   | 43   | 2,38               | 0,00  | 2,38      | 0,00      |
| India      | 11   | 12   | 14   | 14   | 27,27              | 9,09  | 16,67     | 0,00      |
| Italy      | 26   | 26   | 26   | 28   | 7,69               | 0,00  | 0,00      | 7,69      |
| Japan      | 38   | 38   | 38   | 39   | 2,63               | 0,00  | 0,00      | 2,63      |
| Mexico     | 12   | 13   | 14   | 14   | 16,67              | 8,33  | 7,69      | 0,00      |
| Netherlands| 13   | 13   | 13   | 13   | 0,00               | 0,00  | 0,00      | 0,00      |
| Russia     | 18   | 20   | 21   | 22   | 22,22              | 11,11 | 5,00      | 4,76      |
| South Korea| 24   | 24   | 26   | 30   | 25,00              | 0,00  | 8,33      | 15,38     |
| Spain      | 18   | 18   | 18   | 21   | 16,67              | 0,00  | 0,00      | 16,67     |
| Taiwan     | 15   | 15   | 15   | 15   | 0,00               | 0,00  | 0,00      | 0,00      |
| Turkey     | 9    | 10   | 10   | 11   | 22,22              | 11,11 | 0,00      | 10,00     |
| UK         | 69   | 70   | 71   | 71   | 2,90               | 1,45  | 1,43      | 0,00      |
| USA        | 144  | 144  | 154  | 154  | 6,94               | 0,00  | 6,94      | 0,00      |

Considering the growth rate (basic), we can conclude that the greatest success was reached by China (32%), which improves its positions by an average of 9.7%. Also, such countries as India, South Korea, Turkey, and Russia show good results (an increase of 27.3%, 25.0%, 22.2% and 22.2% respectively). The universities of Russia improve their positions by an average of 7%. On the opposite, France shows negative dynamics, a decrease of 2.5%. There are also countries that have no changes for this period (Argentina, Brazil, Canada, Netherlands, Taiwan). Universities of other countries show stable results. It should be noted that here we speak about the presence in the whole rankings, not in top-100 or top-200. However, at the same time, being on the QS list at any position is quite prestigious.

Figure 2 provides evidence that Asian countries are beginning to build up their educational potential. If North America remains the recognized leader in this area, then Europe is gradually losing its position. In this case, the ratings of THE and QS practically coincide.
If we talk about all countries whose universities are on the QS ranking list [5], then we need to refer to Figure 3. It is evident from the pie chart that the universities of Europe are the most represented. Africa has the smallest share, which is quite understandable for the lagging development of this continent. Oceania has a low percentage, due to the fact that it is represented by only one country, Australia. However, its universities are at very good positions. The countries of the Asian continent have a high share at the expense of the newly industrialized countries, China and India. Thus, based on the data of 2016, we can make a final conclusion that the main and fierce competition developed between Europe, North America and Asia.

The study also analyzed the Global Innovation Index, which shows the level of innovation development in the state [4]. The research is carried out according to the methodology of the international business school INSEAD (France) since 2007 and currently represents the most comprehensive set of indicators of innovation development in various countries of the world.

The Global Innovation Index is made up of 80 different variables that detail the innovative development of the countries of the world at different levels of economic development. The authors of the study believe that the success of the economy is related, both to the availability of innovative potential and the conditions for its implementation [4].
Table 2 presents the top-10 countries rating for this index for 2013-2016. The following leaders are obvious: Switzerland, Sweden, Great Britain, the Netherlands and the USA. The main share is occupied by European countries, but in the top 10 there are Hong Kong and Singapore.

| Rank | 2013       | 2014       | 2015       | 2016       |
|------|------------|------------|------------|------------|
| 1    | Switzerland| Switzerland| Switzerland| Switzerland|
| 2    | Sweden     | United Kingdom | United Kingdom | Sweden     |
| 3    | United Kingdom | Sweden     | Sweden     | United Kingdom |
| 4    | Netherlands | Finland    | Netherlands | USA        |
| 5    | USA        | Netherlands | USA        | Finland    |
| 6    | Finland    | USA        | Finland    | Singapore |
| 7    | Hong Kong  | Singapore  | Singapore  | Ireland   |
| 8    | Singapore  | Denmark    | Ireland    | Denmark   |
| 9    | Denmark    | Luxembourg | Luxembourg | Netherlands|
| 10   | Ireland   | Hong Kong  | Denmark    | Germany   |

To establish the correlation between the university rankings with the countries' ranking on the global innovation index, we selected a group of countries and a university which takes the best position in international rankings. Figure 4 shows a graph that clearly demonstrates the relationship between the global innovation index and the international ranking of universities. After the calculations, a linear pair correlation coefficient of 0.913 was obtained, which indicates a high level of coupling between the variables. The coefficient of determination indicates that in 83.35% of cases the changes in $x$ lead to a change in $y$. In other words, the accuracy of selected regression equation is high. The remaining 16.65% change in $Y$ is due to factors not taken into account in the model (as well as by specification errors). The linear regression equation has the form: $y = 3.141x - 4.933$, i.e. relation is direct.

![Figure 4. Relation between Global Innovation Index and country's best university rank in the QS ranking (on 24 countries).](image)

If we consider this issue, taking into account not a specific position in the world ranking of universities, but a share of the country in this rating, one can also notice a certain relationship (Figure 5).
Moreover, we also carried out an analysis by years in three countries: Germany, Russia, China. According to Fig. 6 you can see that the higher the rating of the country in respect of the global innovation index, the higher the share in the international ranking of universities.

Considering the specific positions of the universities of Russia and China, we can also see the relationship with this index (Figure 7). For example, in 2013 Russia was on the 62nd place and Moscow State University occupied 120th place. Today our country occupies the 43rd place in the rankings of the global innovation index, and Moscow State University - 108th place. As for China having risen by 10 positions in the rating of the global innovation index, its university improved its position by 24 places.
If we look closer at Russia (figure 8), we can mention the relation between university ranking and Global Innovation Index rank during 2013-2016. Determination coefficient is pretty high – 85.3%.

Figure 8. Relation between MSU ranking in QS and Russia’s ranking in Global Innovation Index

Conclusion
Thus, in the course of this study, a fairly close correlation between the two ratings was identified, which suggests that strengthening the positions of universities in international rankings can significantly accelerate the country’s innovative development.

Among the reasons for the low ranking of Russian higher education institutions are the following:
1. The low practical importance of scientific research conducted by Russian universities.
2. Modest budgets that do not allow to have a modern material and technical base.
3. Lack of preparation in English. The presence of English-language programs allows you to achieve at once 3 goals: to supplement the budget of educational institutions at the expense of foreign students, to expand the prospects for employment of their own students, to increase the prestige of the institution by attracting foreign professors.
4. Lack of flexibility in training programs. Leading educational institutions are quickly responding to the demand from the labor market, opening up new areas of training and discipline, but the programs of Russian universities are being modernized very slowly [2]. Meanwhile, innovative lagging is impossible to overcome without dramatically improving the quality of Russian education, strengthening its practical orientation, strengthening integration with science and business, without reforming the system of organization of research work of students.

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