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The Russian "Monitoring of Efficiency of Educational Organizations": Consistency, validity and unintended consequences

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Introduction

In Russia, as well as in many other countries, university governance has recently evolved in the direction of market-oriented model (Dobbins et al., 2011) which presumes distributing a significant share of funding on the basis of key performance indicators (KPIs). Since 2012, in distribution of this funding Russian Ministry of Science and Education relies on a complex system of some dozens (93 in 2013 and 2014, 162 in 2015-2017) statistical indicators provided by universities themselves; peer review or expert opinions play no role in defining if a given university is considered "efficient".

This paper will (1) discuss the consistency and reliability of the system of indicators; (2) evaluate its external validity and discuss some conditions such system is to meet to evaluate "quality" in a highly stratified university population (3) analyze the consequences of implementation of the particular system invented by the Russian ministry which, in the authors' esteem, largely failed to meet these conditions.

Some of the measures used in the survey, such as the number of Web of Science and Scopus citations, are highly conventional and are used in the global university rankings worldwide. Others are rather idiosyncratic and probably emerge from the Soviet practices of social planning (such as the size of dormitories). On the basis of these measures, six indicators are calculated which are used for evaluation of university efficiency. These six are presumably reflecting six principal axis of university development - educational activity, research activity, international activity, finance, teaching staff, employment of former students. A university's performance at each of the six key performance indicators is compared to thresholds for these indicators. A university is considered efficient if it scores above the threshold at no less, than four principal dimensions. Those not meeting this standard risk being merged with others (public universities) or having their license withdrawn (private universities).

This approach to university evaluation relies on several strong assumptions. First, it assumes that the relevant characters of universities could be accounted for by six dimensions; second, it assumes that these six dimensions are captured by the indexes calculated by the Ministry; third, it implies that all of these dimensions ultimately evaluate a single underlying quality – efficiency – and that it is likely that the positions of particular HEIs in all of these dimensions

as well as their movements within the space will be correlated. Earlier research in this vein carried out in Russia sought to use data envelopment analysis to create a typology of universities; however, it used only a small subset of measured characteristics (Abankina, 2013).

The ultimate rationale of the introduction of the Survey was the strife to make Russian universities sources of marketable innovations and national soft power. It is widely believed that what they need to achieve this objective is efficient management which is the key to transforming nearly any HEI into a world leading research university. Characteristically, the Survey is called "the Survey of Efficiency" implying that what is distinguishing its leaders from outsiders is the ability to use their resources, rather than the amount and character of the resources available.

This belief lies behind much of the recent interventions within the higher education sphere, intended to provide universities with strong and competent presidential leadership, preferably with experience in business sphere. Merging of public university with better performing HEIs and introduction of appointed rectors instead of elected ones were aimed at providing universities with a more efficient management. However, as the data of the survey demonstrate focusing the reformers' attention on personalities of higher administrators diverts it from other variables influencing a university's trajectory. Factors other than a higher administrator's skills and motivation are necessary for explaining why a given university has occupied a particular niche in the higher education ecology.

Moreover, their results in each of the main indicators were strongly predicating on various structural characters of the position of the university in the higher education system. That brings us to the next major objective of our study – to find out if whatever the Survey measures could be considered "efficiency".

In the final part of our paper we show results of existing policy on survival of universities and to the question of "What are unintended consequences of the survey?"

Data

The main data used in this paper is obtained from the Efficiency monitoring initiated by the We used data collected from 2014 to 2017 for 822 universities and 979 branch campuses. We mainly used subset of data only for universities excluding branches branch campuses. Total number of variables used for preliminary analysis was 70, so we had sample size=822. Then we did initial variable selection and exclude universities that were officially in the survey, but the data were not provided. Sample size N=777 universities, 45 variables (supplementary material). The choice of this subset of variables was based on considerations of 1) having enough variability for conducted analysis and 2) avoiding collinearity (mostly between measures dependent on size).

Methods

Main part of our research concerns finding and proposing dimension of performance based on empirical data. Firstly, using correlation analysis, we found subset of variables that can be used for EFA. We compared results of EFA and ICA for dimensions to find most stable structure.

We used exploratory factor analysis (EFA) and item cluster analysis (ICA) to find out if:

(1) variation between universities could be plausibly reduced to the six-dimensional space (with outliers analysis to mitigate excessive influence of particular universities);
(2) if the chosen indicators are optimal in terms of their correlation with these dimensions. Comparing results of different types of analysis were applied to show most stable relations between indicators.

At the next step of our analysis, we used the positions of universities at major dimensions identified at the first stages of our study as dependent variables. Our hypotheses, based on previous analysis (Sokolov, 2017) were that the whole trajectory of a university's evolution was heavily determined by its "ascriptive" or "inborn" characteristics. We had several classes of independent variables or factors determining its getting into one of the niches, such as (a) if it was public or private; (b) if it was localized in a bigger city or a wealthy region, (c) its nominal profile or "family"[1] enjoying certain prestige and guaranteeing influx of highly motivated students (e.g. an agricultural college is not likely to be as attractive, as an institution specializing on law), (d) its age; (e) its ecological situation at a local market for higher education. As preliminary stage we performed descriptive analysis to support our hypotheses.

In the final part of our research we showed the consequences of implementation of current evaluation system using survival analysis techniques to estimate "survival" for different groups of universities[2].

Results

Factor analysis
Our preliminary descriptive analysis showed that most of the variables are not normally distributed and contain outliers. Thus, we decided to employ robust factor analysis by replacing the sample covariance/correlation matrix by its robust version based on reweighted minimum covariance determinant (RMCD). After comparing solutions for different number of extracted factors we decided that the optimal number of factors is 5. This factor solution explains 36 % of total variance. We used promax method of rotation and principal factor solution as factoring method. Table 1 lists loadings of the first five factors from RMCD-FA (loading greater then 0,2 is in bold). The last line gives the cumulative percentage of explained (robust) variance.

Table 1. Loadings of the five-factor solution (See variable description in the supplement)

Variables	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
USE state-funded	**0,42**	0,18	**0,57**	-0,16	**-0,3**
USE self-paid	0,12	0	**0,43**	-0,02	0,14
min USE	0,02	0,03	**0,32**	-0,13	0,15
special admission	**0,4**	0	**0,45**	**0,23**	-0,14
pct special admission	0,15	-0,05	0,5	**0,24**	**-0,25**
pct master degree	**0,43**	0,14	-0,02	0,11	0,15
pct master first	0,18	0,01	-0,09	0,07	0,04
PhD students	0,07	-0,02	0,08	0,06	**0,27**

[1] "Families" are subsystems of public universities associated with specific sectors of economy and subordinated to respective ministries. They are largely a legacy of the Soviet planning system.
[2] For this part of analysis, we used data for all universities including branch campuses.

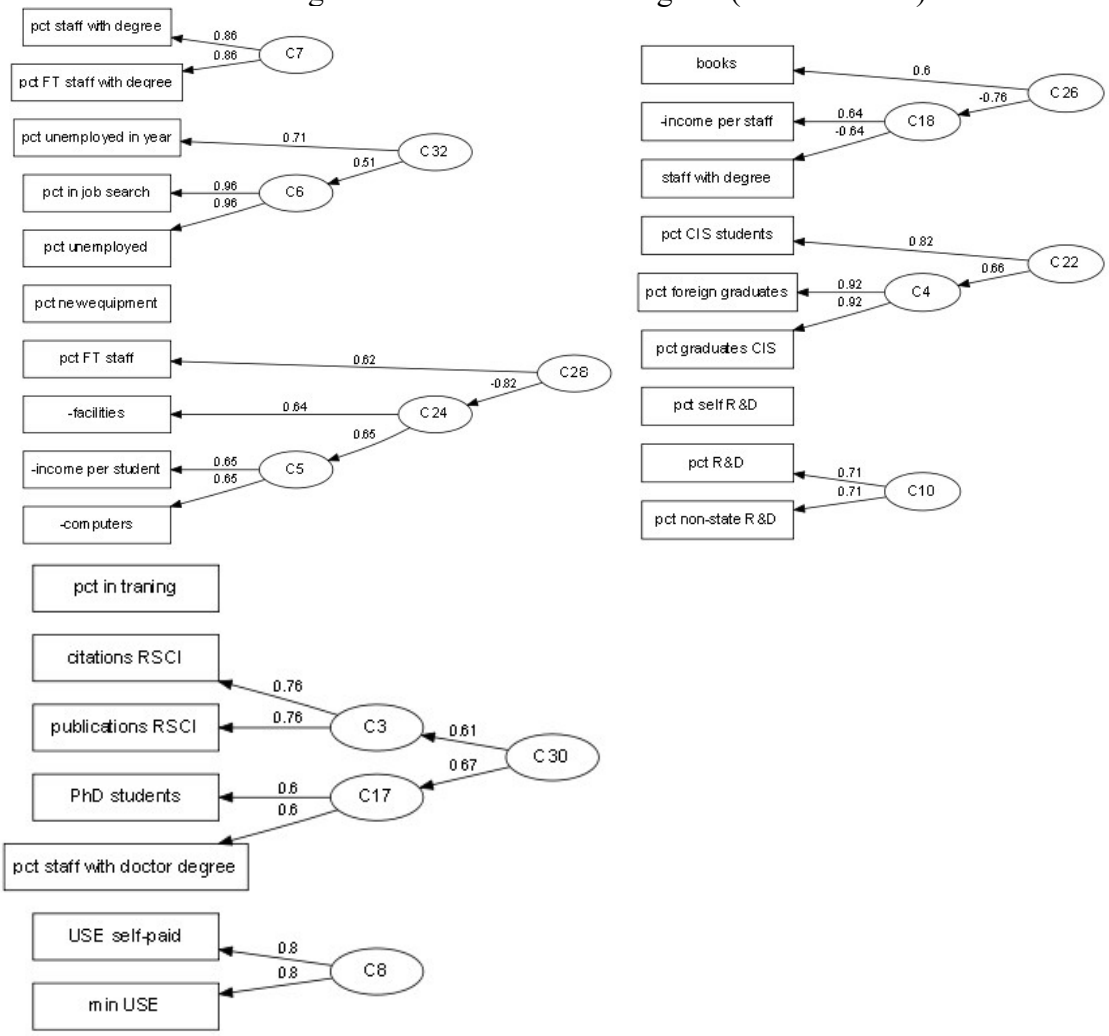
pct in traning	0,06	0,06	0,06	**0,25**	-0,11
citations WoS	0,18	**0,77**	0,09	0,09	-0,07
citations Scopus	**0,2**	**0,73**	0,08	0,07	-0,04
citations RSCI	0,15	0,1	0,03	**0,32**	0,08
publications WoS	0,16	**0,76**	0,09	0,11	-0,02
publications Scopus	**0,22**	0,7	0,14	0,11	-0,03
publications RSCI	**0,26**	**0,2**	-0,07	**0,37**	0,09
income R&D	**0,71**	**0,44**	0,05	0	**0,23**
pct R&D	**0,36**	**0,38**	-0,01	-0,04	**0,29**
pct self R&D	0,05	-0,09	-0,01	0,11	-0,18
pct non-state R&D	**0,29**	**0,23**	-0,19	0,13	**0,37**
pct young staff	**0,3**	0,16	-0,01	**0,32**	-0,17
pct staff gained degree	0,04	0,11	0,14	**0,2**	-0,14
journals	**0,51**	**0,23**	0,09	0,14	0,03
grants	0,11	**0,25**	0,04	0,05	**-0,2**
pct foreign students	**0,26**	0,06	**0,3**	-0,13	0,19
pct CIS students	-0,01	-0,16	0,03	-0,03	**0,37**
pct foreign graduates	0,09	-0,08	**0,29**	-0,16	**0,62**
pct graduates CIS	-0,06	-0,14	0,18	-0,1	**0,63**
income per staff	-0,18	-0,05	**-0,36**	**0,33**	**0,51**
pct salary	**0,46**	**0,22**	0,14	0,08	**-0,26**
income per student	**-0,2**	0,06	0,15	**-0,28**	**0,37**
facilities	**-0,4**	-0,03	-0,06	-0,09	0,08
computers	**-0,21**	0,08	-0,3	0,11	**0,29**
pct new equipment	0	0,12	-0,07	0,13	-0,03
books	-0,04	0,05	0	-0,1	0,09
pct in job search	0,11	-0,07	**-0,6**	-0,04	-0,3
pct unemployed	0,09	-0,08	**-0,59**	-0,03	**-0,26**
pct unemployed in year	**0,22**	-0,05	-0,14	0,02	-0,04
pct staff with degree	0,1	-0,03	**-0,25**	**0,81**	-0,18
pct staff with doctor degree	0,01	0,1	0,18	**0,54**	**0,36**
pct FT staff with degree	0,13	0,04	-0,03	**0,94**	0,01
staff with degree	-0,04	0,15	**0,58**	0,03	-0,05
pct FT staff	**0,46**	0,01	0,05	0,15	-0,25
students	**0,86**	0,14	0,08	0,14	-0,08
employees	**0,85**	**0,26**	**0,25**	0,05	-0,04
FT staff	**0,85**	**0,22**	**0,3**	0,06	-0,06
Cumulative var. %	***0,10***	***0,17***	***0,23***	***0,29***	***0,36***

We interpret factors in the following way. First factor corresponds to characteristics that are closely related to the size of the university. Second factor represents publication activity which is not strongly but also correlates with income, number of faculty and number of received grants. Third factor characterize students' population: selectivity scores and employment of graduates. Fourth factor represents per cent of faculty with higher/lower level degrees. Fifths factor is specifically connected to presence of foreign students and to income coming from this source.

Item cluster analysis

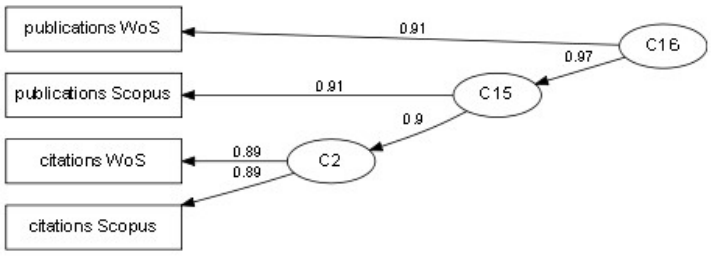
For item cluster analysis we used correlation matrix based on Spearman's correlation coefficients, because they are more robust to outliers than Pearson's. The characteristics of cluster solution are: Cluster fit = 0.81, Pattern fit = 0.96 and RMSR = 0.06. Diagrams for clusters are shown on Figure 1-2. There are several small clusters with sizes no more than 4 variables and one big cluster including 17 variables.

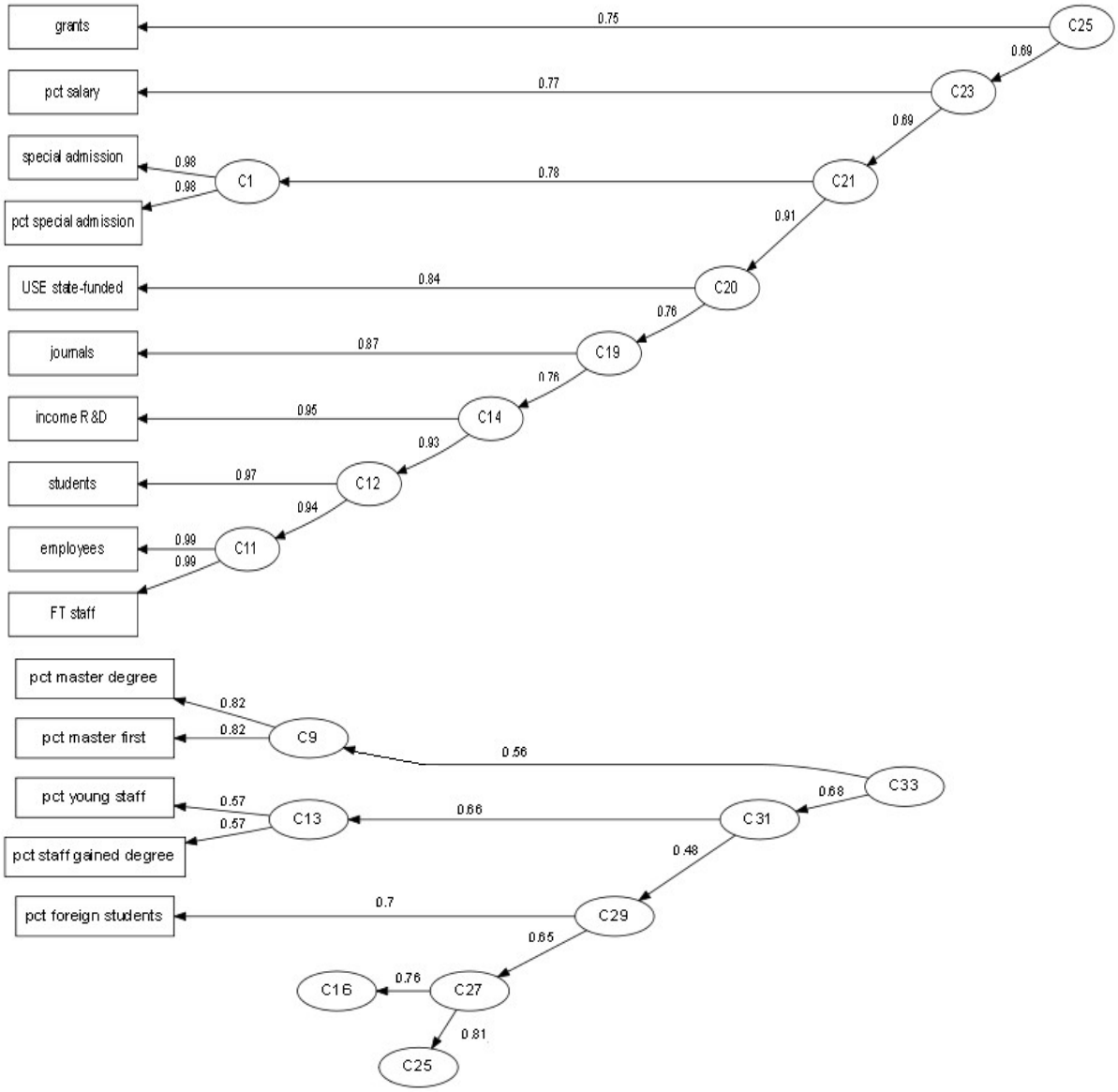
Figure 1: Cluster solution diagram (small clusters)



As you can see from Figure 1 there are several variables that form small clusters. Cluster C30 shows that number of publications in Russian Scientific Citation Index correlates with number of PhD students and doctors. Cluster C22 represents foreign students and Cluster C32 is unemployment rates of graduates.

Figure 2: Cluster solution diagram (big cluster)





One can conclude from the Figure 2 that the big cluster consists of several components: C16 represents publication activity of universities. C9 and C13 are loaded with numbers of MA students and junior employees. Overall this big cluster C33 represents characteristics which are related to the size of the university.

Summarizing the results of EFA and ICA we can say that the size of the university is a major variable accounting for a university's getting high scores at many indicators. Big universities attract students with higher state exam results, can afford having their own periodicals and enroll many MA degree students. They also have advantages over small ones as employers: they do not have to rely on part-timers and have more employees with higher degree. Financially they have bigger income and receive more grants despite not necessarily having better equipment.

Ascriptive characteristics

For the most indicators the results of descriptive analysis showed that the ascriptive variables account for a large share of variance, with families being particularly important (Figure 3).

Figure 3: Number of publications in different families of universities

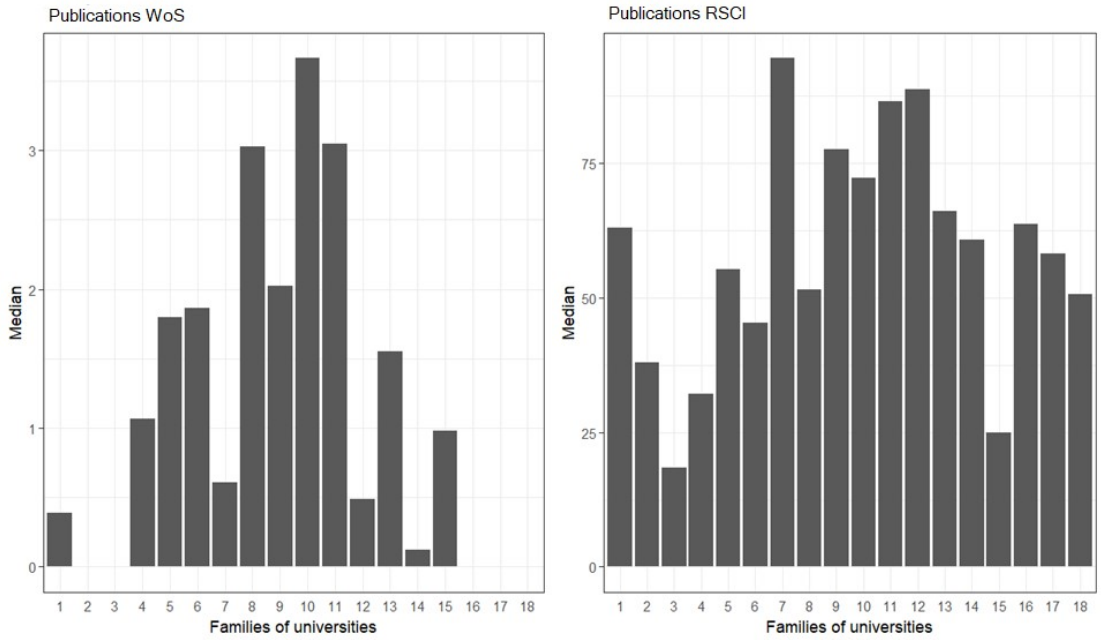
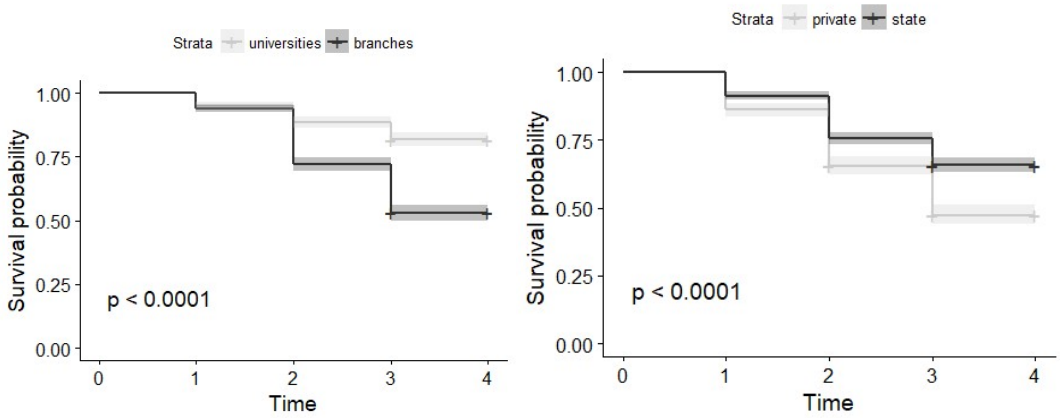


Figure 3 shows that extreme variability exists between different university families. Thus, so-called "classical", polytechnic and medical universities have higher median number of publications in Web of Science that others, while universities majoring in social and economic sciences, especially ones attached to various ministries have the highest median number of publications in Russian Scientific Citation Index. Differences of a comparable scale exist in other KPIs, such as the amount of research funding, number of students coming abroad, or laboratory spaces. Overall, origins and present institutional attachment of a university to a given "family", together with other structural factors such as localization in a given region, explain the better part of variance in the university's performance.

Survival analysis

What were the consequences of implementing efficiency metrics not taking into account structural variables which influence a university's performance? Our data demonstrate that such KPI's discriminated against specific groups of universities. Survival curves for universities from 2014 to 2017 demonstrate that private universities and branches in minor cities were among the major victims (Figure 4).

Figure 4: Survival curves based on Kaplan-Meier estimates



Discussion

Overall, it seems that choosing a set of performance indicators without enough regard to the structural sources of variation results in the survival of the best positioned, rather than the fittest or the most efficient. An old sociological wisdom says that a fair competition among unequal participants just increases the gap and serves only to legitimize the winner's advantage. Without considering the role of these factors, allocation of resources on the bases of universal formal criteria which is practiced in Russia now would inevitably lead to polarization of the higher education system and to degradation of the schools which were initially lacking "inborn" characters essential for success.

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Supplementary material

Table A. Description of variables (2014)

Variable name	Description
Name	Description
USE state-funded	Average score in Unified State Exam of students accepted to state-funded places
USE self-paid	Average score in Unified State Exam of students accepted to self-paid places
min USE	Minimum score in Unified State Exam of accepted students
special admission	Number of students accepted on special admission
pct special admission	Percentage of students accepted on special admission
pct master degree	Percentage of master's degree students
pct master first	Percentage of first year master's degree students
PhD students	Number of PhD students
pct in traning	Percentage of students taking training programs
citations WoS	Number of citations in Web of Science
citations Scopus	Number of citations in Scopus
citations RSCI	Number of citations in Russian Scientific Citation Index
publications WoS	Number of publications in Web of Science
publications Scopus	Number of publications in Scopus
publications RSCI	Number of publications in Russian Scientific Citation Index
income R&D	Income from research and development projects
pct R&D	Percentage of income from research and development projects
pct self R&D	Percentage of income from research and development projects without involvement of co-executors
pct non-state R&D	Percentage of income from research and development projects without state-funded projects
pct young staff	Percentage of young employees in teaching and research staff
pct staff gained degree	Percentage of employees gained degree in teaching and research staff
journals	Number of published scientific journals
grants	Number of received grants
pct foreign students	Percentage of foreign students
pct CIS students	Percentage of students from Commonwealth of Independent States
pct foreign graduates	Percentage of foreign students who graduated
pct graduates CIS	Percentage of students from Commonwealth of Independent States who graduated
income per staff	Income per teaching and research staff member
pct salary	Ratio of average salary comparing to regional one
income per student	Income per student
facilities	Total area of teaching and laboratory facilities per student
computers	Number of personal computers per student
pct new equipment	Percentage of costs for machinery and equipment (not older than 5 years) in all
books	Number of books in the library per student
pct job search	Percentage of graduates who applied for assistance in finding a job
pct unemployed	Percentage of unemployed graduates who applied for assistance in finding a job

pct unemployed in year	Percentage of unemployed graduates who applied for assistance in finding a job during the year
pct staff with degree	Percentage of employees with PhD and Doctor of Sciences degree in teaching and research staff
pct staff with doctor degree	Percentage of employees with Doctor of Sciences degree in teaching and research staff
pct FT staff with degree	Percentage of employees with PhD and Doctor of Sciences degree in teaching and research staff (without part-time staff)
staff with degree	Number of employees with PhD and Doctor of Sciences degree in teaching and research staff per student
pct FT staff	Percentage of full-time employees in teaching and research staff
students	Number of students
employees	Number of employees