

The Use of Correlation Analysis in the Research of Higher Education in Russian Federation

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ABSTRACT

The research explores the socio-economic factors of higher education on the basis of correlation analysis. The purpose of this analysis is to identify the connection between various factors according to the results of observations of their indicators, along with identifying the measure of their reciprocal impacts. The indicators of higher education in the current research are the number of higher education and scientific institutions, the number of faculty members under the undergraduate, specialty, master's programs, graduation of bachelors, specialists, masters. As indicators of socio-economic factors of higher education, the number of unemployed people, per capita income, gross domestic product, advanced production technologies, the volume of innovative goods, work, services. By the research results the authors conclude, that, firstly, the number of students depends on inside university factors (the quality of education, the organization of education process etc.); secondly, higher education does not directly influence scientific activity of organizations and implementation of its development results into practice. Besides mentioned there was the following hypothesis. In particular, it seems, that ruling Russian elite, faced the decrease of gross domestic product and its negative consequences, affected the budget revenues, began to systematically reduce the expenditures of public agencies (including its expenditures on higher education) regardless to economic conjuncture. Meanwhile, the current situation accompanies by the desire of the ruling elite to significantly enhance the national scientific potential. This hypothesis needs to be verified, which the authors will check in further studies.

Keywords: *Socio-economic factors, Higher education, Correlation analysis.*

1. INTRODUCTION

The sphere of higher education in Russia has undergone significant metamorphoses in recent decades. This is confirmed by the dynamics of the number of students of higher educational institutions [1]. It is improbable that such a scope of fluctuations (approximately a threefold increase over the initial amount) indicates only quantitative modifications. Qualitative changes are almost inevitable in this case. The main factor indisputably will be the number of populations aged 20-24 years. Even though, impact of economy, state policy, quality of education, image of university, demand for graduates of higher institution in labor market etc. should not be belittled. In this case it

will be useful to find out which factors influence higher education and what the mechanism of this influence is.

It is not necessary to conduct laborious and time-consuming methods like opinion poll or observation to respond on this question. The use of analysis of statistical data is enough. That is why the correlation analysis, as main method of the research, gives opportunity to identify a difficult complex of causation and incidence. It's necessary to mention that correlation analysis not only helps to identify the causes of any type of facts, but also allows to establish a connection with other social phenomena.

In the domestic research field, the theme of the influence of various factors on higher education is explored by G.M.Galieva, E.V. Zhilina [2],

A.V.Kashepov [3], V.B.Teplyakov, D.O.Belov, M.A.Cherepanova [4], T.V. Zak [5], N.A. Suvorov [6], M.V.Boguslavsky, I.D. Lelchitsky [7].

Foreign studies on this topic, which are presented in publications of G.Almerich, J.Suarez-Rodriguez, I.Diaz-Garcia, N.Orellana [8], C.Paterson, N.Paterson, W.Jackson, F.Work [9], Z.N.Baysal, K.E. Araç [10], Y. Gao [11], I.Eriņš, S.Karkliņa [12], L.-H.Zhang, E.-X. Luo. [13], Liu Shengbo, Liu Miaomiao, Jiang Hua [14], V.Papatsiba, E.Cohen [15] deserve attention, too

2. METHOD

This research is an interpretive case study. It will explore the process of input acquisition as a part of the spiritualism-based MCS. The data was collected through interviews, observations, and documentations. We interviewed the owner, employees, and suppliers. The following table 1 showed a list of participants interviewed.

The correlation analysis used in this work is one of the most efficient statistical methods. It contributes to the reveal of connections between the researched factors and also defines the degree of their interactions. The correlation coefficient is the quantitative result of all the calculations [16, 17, 18, 19]. The most of the social relation studies take into account the linear dependence between the factors that leads to usage of the Pearson correlation coefficient, calculated by the formula below:

$$r_{xy} = \frac{\sum xy - \frac{\sum x \sum y}{n}}{\sqrt{\left(\sum x^2 - \frac{(\sum x)^2}{n}\right) \left(\sum y^2 - \frac{(\sum y)^2}{n}\right)}}$$

The correlation coefficient changes its scale from -1 to +1. The most commonly used differentiation of its value is listed below:

- if $0,7 < r_{xy} < 1$ and $-1 < r_{xy} < -0,7$ - the dependence is strong (close connection);
- if $0,3 < r_{xy} < 0,7$ or $-0,7 < r_{xy} < -0,3$ - the dependence is middle;
- if $0 < r_{xy} < 0,3$ and $-0,3 < r_{xy} < 0$ - the dependence is rather weak;
- if $r_{xy} = \pm 1$ - the dependence is functional;
- if $r_{xy} = 0$ - there is no any dependence between the data under consideration.

The implementation order of the given statistical methods includes three steps:

1. selection and clustering of indicators by statistical data;
2. calculation of the Pearson correlation coefficient;

3. interpretation of the calculated correlation coefficients.

The modern development of information technologies significantly simplifies the use of the correlation analysis (in this case the authors use Microsoft Excel functions). The main sticking point is the interpretation of the received data. In this respect it definitely should be taken into account.

On the basis of the literature review the following assumptions were made:

1. Economic factors have a significant influence on higher education in modern Russia;
2. Russian higher educational institutions are the main driving force of science.

3. RESULTS AND DISCUSSION

The authors choose given below factors as quantitative indicators defining university condition:

- the total number of higher education and scientific institutions;
- the total number of faculty members under the undergraduate, specialty, master's programs;
- the graduation of bachelors, specialists, masters.

As indicators of factors capable of influencing higher education the following socio-economic factors were chosen:

- the total number of unemployed people aged 15-72 years;
- per capita income;
- gross domestic product;
- the revenues of consolidated budget;
- advanced production technologies;
- the volume of innovative goods, work, services.

This list indisputably is not limiting. However, it has a quite wide spectrum. Particularly, economic factors are characterized by gross domestic product, number of unemployed people, per capita income. The revenues of consolidated budget characterize the possibilities of state influence. Scientific sphere may be characterized by advanced production technologies and the volume of innovative goods, work, services.

The most obvious dependences are the total number of higher education and scientific institutions and the number of faculty members under the undergraduate, specialty, master's programs ($r_{xy}=0,96$), the total number of higher education and scientific institutions and the number of students ($r_{xy}=0,97$). Any additional interpretations of direct and strong interactions are needless.

Table 1. Economic Factors

		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	the total number of higher education and scientific institutions	1068	1090	1108	1134	1114	1115	1080	1046	969	950	896	818	766
2	the total number of faculty members under the undergraduate, specialty, master's programs	358800	378400	388100	418800	377800	356827	348160	342030	319348	299750	279758	260980	245078
3	graduation of bachelors, specialists, masters, thousand people	1151,7	1255,0	1335,5	1358,5	1166,9	1467,9	1442,9	1397,2	1291,0	1226,2	1300,5	1161,1	969,5
4	the total number of students, thousand people	7064	7310	7461	7513	7419	7050	6490	6075	5647	5209	4766	4399	4246
5	the total number of unemployed people aged 15-72 years, (under sample surveys of labor force), thousand people	5263	5312	4589	4791	6284	5544	4922	4131	4137	3889	4264	4243	3967
6	per capita income, rubles in a month	8112	10196	12603	14941	16895	18958	20780	23221	25928	27755	30467	30747	31422
7	gross domestic product, billion rubles	21610	26917	33248	41429	39101	46309	55967	62176	66190	71406	83387	86149	92037
8	the revenues of consolidated budget, billion rubles	2999,9	3797,3	4828,5	6198,8	13599,7	16031,9	20855,4	23435,1	24442,7	26766,1	9308,2	9923,8	10758,1
9	advanced production technologies	637	735	780	787	789	864	1138	1323	1429	1409	1398	1534	1402
10	the volume of innovative goods, work, services, million rubles	545540,0	777458,1	958928,7	1103365,5	934589,0	1243712,5	2106740,7	2872905,1	3507866,0	3579923,8	3843428,7	4364321,7	4166998,7

Table 2. Matrix Correlation

	line 1	line 2	line 3	line 4	line 5	line 6	line 7	line 8	line 9	line 10	line 11	line 12
Line 1	1,00											
Line 2	0,96	1,00										
Line 3	0,64	0,52	1,00									
Line 4	0,97	0,98	0,46	1,00								
Line 5	0,68	0,64	0,15	0,75	1,00							
Line 6	-0,84	-0,88	-0,24	-0,93	-0,68	1,00						
Line 7	-0,88	-0,90	-0,30	-0,95	-0,72	0,99	1,00					
Line 8	-0,12	-0,27	0,29	-0,32	-0,34	0,51	0,42	1,00				
Line 9	-0,82	-0,85	-0,19	-0,92	-0,79	0,95	0,95	0,59	1,00			
Line 10	-0,90	-0,91	-0,32	-0,97	-0,80	0,97	0,97	0,46	0,98	1,00		

There is an average connection between three above mentioned factors and the graduation of bachelors, specialists, masters ($r_{xy}=0,64$, $r_{xy}=0,52$, $r_{xy}=0,46$ respectively). It seems that inner university factors (for instance, the quality of education services) and the coincidence of students' expectations with the real conditions of study has a noticeable effect on the number of students. Collateral substantiation is the fact that the correlation coefficient between the graduation of bachelors, specialists, masters and other indicators does not surpass 0,32

The strong and negative dependence between the indicators of higher education and economic as well as scientific factors provokes bemusement. In particular, to interpret directly the increase of per capita income and gross domestic product leads to the reduce of the amount of higher education and scientific institutions, the number of faculty members under the undergraduate, specialty, master's programs and the number of students. It is more or less strange. It should seem that the increase of people's revenues would lead to the increase of possibilities to obtain higher education, which under some research gives a "bonus" to the salary from 30% to 70% [20], but it does not happen. Moreover, the dependence between gross domestic product and per capita income ($r_{xy}=0,99$), as well as the dependence between the total number of unemployed people aged 15-72 years ($r_{xy}=-0,72$) are clear enough and do not provoke any bemusement.

Such state of results is difficult to explain, nevertheless, the following can be put forward as a hypothesis. Firstly, there is a probable coincidence of changes in economic indicators and state policy, aimed at reducing the number of universities and students since 2009.

Secondly, despite the changes of economic conjuncture the ruling elite might have begun to diligently reduce budget expenditures (including the expenditures on higher education), when it faced the decrease of gross domestic product (and/or predicting a consequent decrease in budget revenues in the future). Coincidence for the year (2009) of decrease in gross domestic product, the number of students, the number of higher education and scientific institutions and the number of faculty members in universities performs for this assumption.

The revenues of consolidated budget are weakly connected with the indicators of higher education (the correlation coefficient does not exceed 0,32 in modulo). The increase of the first does not lead to the quantitative changes of the last. This fact confirms the last hypothesis.

The dependence between the graduation of bachelors, specialists, masters and advanced production technologies ($rx_{y1}=-0,19$), as well as the volume of innovative goods, work, services ($rx_{y2}=-0,32$) is weak. However, the connection between two last indicators with the total amount of higher education and scientific institutions, the amount of faculty members in universities and the number of students is inverse and strong ($rx_{y3}=-0,82$, $rx_{y4}=-0,85$, $rx_{y5}=-0,92$, $rx_{y6}=-0,9$, $rx_{y7}=-0,91$, $rx_{y8}=-0,97$ respectively).

It may be explained in the same way. Possibly, the ruling elite facing the decrease of gross domestic product began to encourage innovative activities of organizations with a simultaneous reduction in budget expenditures (including expenditures directly to higher education). It should be emphasized that this explanation is hypothetical.

The absence of direct dependence between higher education and science seems more verifiable. The change in the number of university graduates does not affect scientific indicators. The latter are in closer connection with gross domestic product ($rx_{y9}=0,95$, $rx_{y10}=0,97$). The influence of the revenues of consolidated budget on them is less intensive, but also substantial ($rx_{y11}=0,59$, $rx_{y12}=0,46$).

4. CONCLUSION

The conclusions which hardly require additional verification might be the following.

1. The number of students by far depends on inner university factors, such as the quality of education, its correspondence to students' expectations, organization of studying process. Not all students become graduates. But the reason for this difference should not be attributed solely to the refusal to continue training due to the poor quality of the latter. Student expulsion as a result of academic or financial debt should also be considered as a significant factor.
2. Higher education does not directly influence scientific activity of organizations and implementation of its results into practice. Undoubtedly, higher education teaching personnel conducts scientific research, and these activities are more or less included in their working duties, but their results are approbated mainly in the form of scientific publications, and they are not implemented into production. The economic condition by far influence scientific activity, when positive economic conjuncture allows to allocate additional resources. State policy to support the innovative activity of organizations should also be attributed to a significant factor in scientific activity.

Another group of results, which additionally needs to be scientifically checked, is the following:

1. Despite the economic conjuncture the ruling elite has begun to diligently reduce budget expenditures of public agencies, when it faced the decrease of gross domestic product and its negative consequences reflected on revenues. One of the expense items that have been reduced is higher education.
2. Mentioned above does not exclude the aspiration of the ruling elite to significantly enhance the national scientific potential. Symptoms of their aspirations are identified in this study.

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