ECONOMIC CONSULTANT

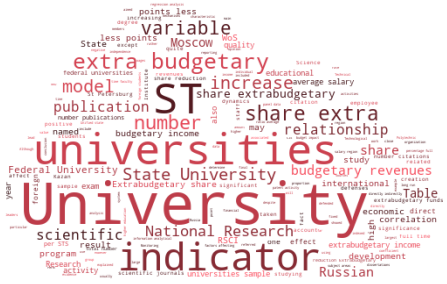
MANAGEMENT IN EDUCATION / JEL I22

D. G. Sandler, D. A. Gladyrev

Factors influencing on extra budgetary income of leading Russian universities: econometric analysis

KEYWORDS

university economics;
higher education management;
university strategy;
university competitiveness;
entrepreneurial universities;
extrabudgetary revenues;
scientometrics



Word Cloud Generated by:
https://wordscloud.pythonanywhere.com/

ABSTRACT

This study is aimed to study the mechanisms that contribute to increasing the economic independence of universities, which in conditions of high dependence on-budget funding is exceptionally relevant in Russia. Even though the share of extra-budgetary revenues is growing at most Russian universities, this growth is heterogeneous and partly due to the "low base effect".

To determine the factors of economic independence of universities, we used data on the 49 largest universities in Russia over four years, taken from monitoring the effectiveness of higher educational institutions. The primary research method is regression analysis using panel data models.

The analysis reveals that the share of extra-budgetary funds of the university is positively influenced by factors such as the number and quality of publications, the number of journals published by the university, and the ratio of employees to the regional average. These dependencies are important in the long-term comprehensive planning of university activities.

FOR CITATION

Sandler, D. G., & Gladyrev, D. A. (2020). Factors influencing on extra budgetary income of leading Russian universities: econometric analysis. *Economic consultant*, *30* (2), 36-47. doi: 10.46224/ecoc.2020.2.4

INTRODUCTION

The development of the higher education system in Russia is one of the priority areas of state policy, as evidenced by such initiatives as the creation and development of federal universities, research university programs (hereinafter NII), the program for increasing international competitiveness "5-100", universities as centres for the creation of innovations, programs of supporting universities. The targets for these programs contain both scientific and economic variables. Although the role of the latter is somewhat underestimated, it is proved that the achievement of scientific indicators ultimately has a positive effect on economic indicators [9].

There are quite a few works dealing with factors affecting individual sources of extra-budgetary income of a university, for example, the number of patents and startups. In particular, the influence of the average age of employees (inverse relationship), the size of the university, and the characteristics of the country or region where the university is located were proved [8]. In some works, a connection was noted between the university's business indicators and the quantity and quality of its publications. It was found that patent and publication activity, despite the rather popular opinion of poor compatibility with each other [13], is in fact, directly related [1, 4, 11]. The high patent activity of individual researchers is usually associated with the high quality of previous publications and a large number of subsequent publications [3]. At the same time, the most prominent scientists usually do not have high patent activity [7]. Also, a positive relationship was found between the university's publication activity and other indicators of entrepreneurial activity, such as the amount of R&D and the number of spin-offs [14]. All these results can be explained by the fact that the listed variables are united by one common characteristic, which can be called "research efforts and competencies" [2]. Also among the factors affecting the entrepreneurial activity of the university, the quality of education [10], the university's connection with the industry [5, 12] and the employee compensation system [6, 15] are noted.

At the same time, existing studies practically do not consider the economic independence of universities, especially relevant in Russia, given the significant state funding of universities. Although government initiatives involve a large amount of budget funding, they also aim to increase the economic independence of universities, especially in the long run. This study is aimed at studying the factors affecting the share of extrabudgetary revenues of Russian universities. These factors must be taken into account when forming comprehensive university development plans.

DATA AND METHODS

The study is based on the application of economic, structural and scientometric data on the 49 largest universities in Russia over four years (2015–2018). It is noteworthy that most

of the external "shocks" (for example, the creation of federal universities, the start of the "5-100" program) are outside the period under review, and this allows focusing on studying the relationship between the university's intnal indicators rather than modelling these "shocks".

The sample included universities participating in the 5-100 project, federal universities (except Krymsky University due to the recent date of its formation), NRU (except Nanotechnology Research and Education Centre of the Russian Academy of Sciences named after Zh. I. Alferov), as well as Russian universities to international QS or THE ratings (as of March 2020).

Table 1

List of Universities included in the sample

No	University	5-100	Federal Universities	NRU
1	Immanuel Kant Baltic Federal University	+	+	
2	Belgorod State National Research University			+
3	Voronezh State University			
4	Higher School of Economics	+		+
5	Far Eastern Federal University	+	+	
6	Irkutsk National Research Technical University			+
7	Kazan (Volga region) Federal University	+	+	
8	Kazan National Research Technical University			+
9	Kazan National Research Technological University			+
10	Mordovian State University named after N. P. Ogaryov			+
11	Moscow Aviation Institute			+
12	Moscow State Institute of International Relations (MGIMO)			
13	Moscow State University of Civil Engineering			+
14	Moscow State Technical University named after N. E. Bauman			+
15	Moscow State University			
16	Moscow Institute of Physics and Technology	+		+
17	Moscow Power Engineering Institute			+
18	National Research Technological University “MISiS”	+		+
19	National Research University "Moscow Institute of Electronic Technology"			+
20	ITMO National Research University	+		+
21	National Research Nuclear University MEPhI	+		+
22	Nizhny Novgorod State University named after N. I. Lobachevsky	+		+
23	Novosibirsk State Technical University			
24	Novosibirsk State University	+		+
25	Perm State University			+
26	Perm National Research Polytechnic University			+
27	Russian State University of Oil and Gas named after I. M. Gubkin			+
28	Russian Academy of National Economy and Public Administration			
29	Russian National Research Medical University named after N. I. Pirogov			+
30	Peoples' Friendship University of Russia	+		
31	Russian University of Economics named after G. V. Plekhanov			

32	Samara National Research University named after Academician S. P. Korolyov	+		+
33	St. Petersburg Mining University			+
34	St. Petersburg State University			
35	St. Petersburg State Electrotechnical University "LETI"	+		
36	St. Petersburg Polytechnic University of Peter the Great	+		+
37	Saratov State University named after N. G. Chernyshevsky			+
38	Northern (Arctic) Federal University		+	
39	Northeastern Federal University		+	
40	North Caucasus Federal University		+	
41	Sechenovskiy University	+		
42	Siberian Federal University	+	+	
43	Tomsk State University	+		+
44	Tomsk Polytechnic University	+		+
45	Tyumen State University	+		
46	Ural Federal University	+	+	
47	Financial University under the Government of the Russian Federation			
48	South Ural State University	+		+
49	Southern Federal University		+	

Data on universities are taken from Information and analytical materials based on the results of monitoring the effectiveness of the activities of educational institutions of higher education. Monitoring is carried out according to 63 variables, divided into seven categories: educational, research, international, financial, and economic activities, infrastructure, graduate employment, staffing.

The primary research method is regression analysis using panel data models. Despite the potential promise of using lag variables, the effect of using many mechanisms may be delayed. Therefore, in this study, lag variables are not considered because of the small number of years available for analysis.

RESULTS

The dynamics of the share of extra-budgetary income by universities in the sample (Fig. 1) demonstrates the increase in the share of extra-budgetary income for all groups of universities in the sample. However, despite the similar dynamics, the average values for individual groups differ significantly: in particular, federal universities have a lower share of extra-budgetary income, and metropolitan universities, by contrast, a higher share of extrabudgetary income.

A detailed analysis of this dynamics (Table 2) leads to the conclusion that an increase in the share of extra-budgetary revenues from 2015 to 2018 was demonstrated by 42 of the 49 sample universities. All Federal Universities and all Moscow Universities from the sample showed an increase in the share of extra-budgetary revenues, except one (NRU MGSU).

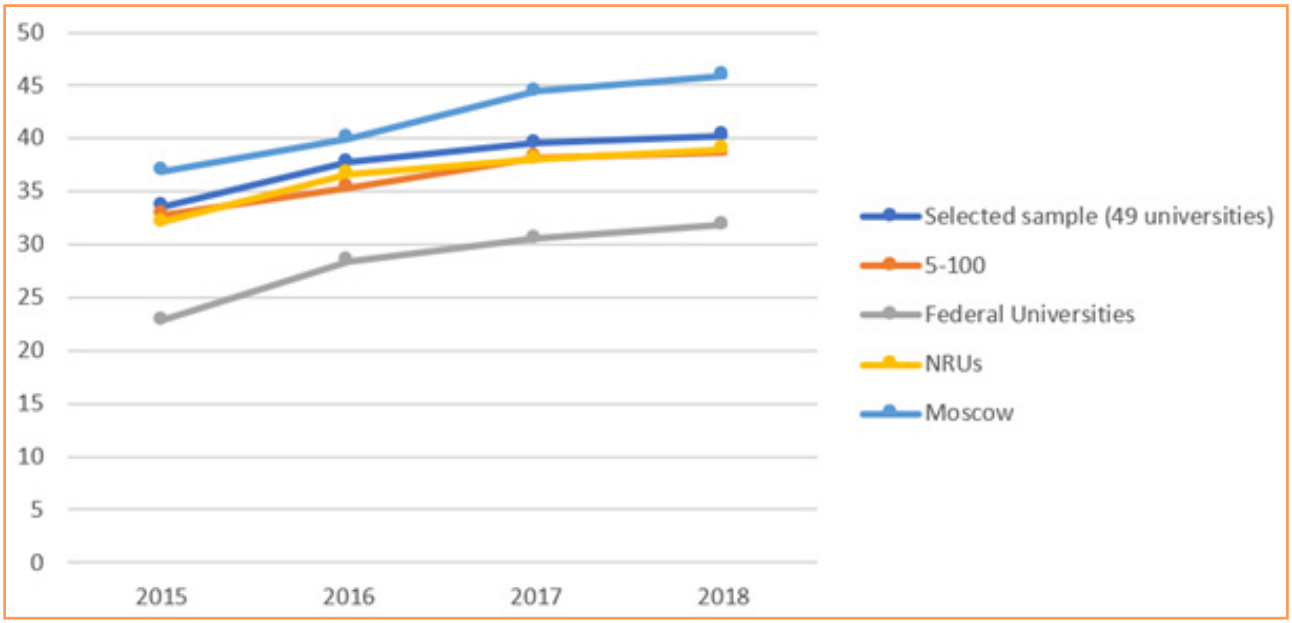


Figure 1 The share of extrabudgetary funds by a group of Universities (2015–2018)

Table 2

Number of universities in the sample, according to their share change extrabudgetary funds from 2015 to 2018

Whole sample – 49 universities			
Extrabudgetary share reduction		Extrabudgetary share increase	
7 (14,3%)		42 (85,7%)	
more than 10 points	less than 10 points	less than 10 points	more than 10 points
2 (4,1%)	5 (10,2%)	29 (59,2%)	13 (26,5%)
«5-100» – 21 universities			
Extrabudgetary share reduction		Extrabudgetary share increase	
3 (14,3%)		18 (85,7%)	
more than 10 points	less than 10 points	less than 10 points	more than 10 points
1 (4,8%)	2 (9,5%)	11 (52,4%)	7 (33,3%)
Federal universities – sample of 9			
Extrabudgetary share reduction		Extrabudgetary share increase	
0 (0%)		9 (100%)	
more than 10 points	less than 10 points	less than 10 points	more than 10 points
0 (0%)	0 (0%)	5 (55,6%)	4 (44,4%)
NRU – sample of 28 universities			
Extrabudgetary share reduction		Extrabudgetary share increase	
4 (14,3%)		24 (85,7%)	
more than 10 points	less than 10 points	less than 10 points	more than 10 points
1 (3,6%)	3 (10,7%)	17 (60,7%)	7 (25%)
Moscow universities – sample of 17 universities			
Extrabudgetary share reduction		Extrabudgetary share increase	
1 (5,9%)		16 (94,1%)	
more than 10 points	less than 10 points	less than 10 points	more than 10 points
0 (0%)	1 (5,9%)	11 (64,7%)	5 (29,4%)

Table 3 shows the leaders in reducing and increasing the share of extrabudgetary revenues from 2015 to 2018. It is noteworthy that the main reason for the increase in the share of extrabudgetary income among the leaders was the direct increase in extrabudgetary incomes, while the leaders in reducing the share of extrabudgetary incomes were diverse: they may be hidden both in a decrease in extra-budgetary revenues, and in an increase in the share of budget financing, or a combination of these reasons.

Table 3

Universities with the largest change in the share of extra-budgetary revenues from 2015 to 2018

Top-5 universities samples to reduce the share of extra-budgetary revenues		Top-5 universities samples to increase the share of extra-budgetary revenues	
Kazan National Research Technological University	49,5% -> 38,3%	Moscow Energy Institute	6,5% -> 42,1%
St. Petersburg State Electrotechnical University "LETI"	44,4% -> 34,3%	Saratov State University	3,6% -> 29,6%
ITMO National Research University	35,3% -> 29,4%	Kazan Federal University	29,7% -> 52,1%
Perm National Research Polytechnic University	55,6% -> 50,2%	North Caucasus Federal University	19,5% -> 35,2%
Tyumen State University	64% -> 59,1%	Sechenov University	35,2% -> 50,7%

For determining the factors affecting the share of extrabudgetary revenues, a regression analysis was performed using panel data models. The share of extra-budgetary income of the university was taken as the studied variable. For the creation of a model, it is necessary to determine the variables with which the indicator understudy will be explained.

Since the purpose of the study is to determine the mechanisms and competencies, the use of which allows directly or indirectly increasing the share of extra-budgetary funds of the university, the model does not include variables that are a direct measure of those or other components of extra-budgetary income: income from research and development work (hereinafter – R&D), the amount of paid admission, the number of grants won and the number of startups.

At the same time, the model includes indicators from Monitoring the performance of educational institutions of higher education. These indicators, on the one hand, quite fundamentally determine what a university is. On the other hand, all these indicators can be targeted in university development programs and improve as a result of the implementation of specific strategies. These are indicators of the quality of admission, the quality and number of publications, the current dynamics of defenses, the number of scientific journals, the share of international students and Scientific and teaching staff (after this referred to as the STS), the indicator of salary, the share of STS with a scientific degree and the share of full-time teaching staff. All selected indicators are described in Table 4.

The study originally planned to use the number of publications indexed in the Web of Science database (after this referred to as WoS) per 100 STS. However, a preliminary analysis of

the data showed an extremely high (0.8) correlation with the citation rate of WoS publications per 100 STS, which makes it impossible to use of both indicators in the model simultaneously. It was decided to include an indicator of the number of citations in the final model. However, the fact of such a close relationship between the number and quality of publications deserves special mention as evidence that the dilemma of choosing between the number and quality of publications is exaggerated, and these indicators usually have common dynamics.

Table 4

Variables selected for inclusion in the model

Variable	Description
Exam point, Unified state exam	Averaged by the implemented areas (specialities) the minimum score of the exam for students accepted by the results of the exam for full-time study at the undergraduate and speciality programs
WoS Citation Count per 100 STS	The number of citations of publications published over the past five years, indexed in the information-analytical system of scientific citation WoS per 100 STS
RSCI publications at 100 STS	The number of publications of the organization indexed in the information-analytical system of scientific citation of RSCI, per 100 STS
The share of defended STS for the reporting year	The proportion of scientific and pedagogical workers who defended their candidate and doctoral dissertations for the reporting period in the total number of STS
Number of scientific journals	The number of scientific journals, including electronic, published by an educational organization
Share of foreign students (except CIS)	Percentage of international students (except for countries of the Commonwealth of Independent States (after this referred to as the CIS)) studying undergraduate, speciality, and master's programs in the total number of students (reduced contingent)
Share of foreign STS	The proportion of the number of foreign citizens from STS in the total number of STS
The ratio of the average salary of the STS to the average salary of the region	The ratio of the average STS salary in an educational organization (from all sources) to the average salary in the region's economy
Graduated STS	The proportion of STSs with a PhD and Doctor of Science degree in the total number of STS educational organizations (without part-time workers and working under civil law contracts)
The percentage of full-time faculty	The percentage of full-time faculty in the total number of faculty

The correlation matrix (Table 5) demonstrates that the relationship between the other indicators is quite moderate, so their simultaneous use in the model will not lead to the creation of a multicollinearity problem.

As a result of econometric modelling, taking into account the panel data structure, a through model, a model with fixed and random effects, was compiled. The application of Wald and Hausman tests showed that the model with fixed effects describes the specifics of the interconnections between the indicators of Russian universities most optimally – it was she who was chosen as the final one.

Table 5

The correlation matrix of the variables in question

	Extrabudgetary	Unified state exam	WoS	RSCI	Defenses	Magazines	Foreign students	Foreign STS	Average salary	With degree	Staff members
Extrabudgetary	1,00										
Unified state exam	-0,01	1,00									
WoS	-0,14	0,48	1,00								
RSCI	0,22	0,03	0,07	1,00							
Defenses	0,04	0,18	0,07	-0,11	1,00						
Magazines	0,14	0,12	0,05	0,14	-0,10	1,00					
Foreign students	0,40	0,19	0,17	0,09	0,22	0,10	1,00				
Foreign STS	-0,05	0,45	0,49	0,17	0,17	0,12	0,21	1,00			
Average salary	0,03	0,17	0,22	0,11	0,08	0,13	-0,06	0,36	1,00		
With degree	0,00	-0,09	-0,11	0,21	0,20	-0,03	0,17	-0,04	-0,17	1,00	
Staff members	0,14	-0,35	-0,58	0,03	-0,13	0,14	0,00	-0,17	-0,16	0,31	1,00

Table 6

Final model

Variable understudy – Share of university extrabudgetary funds

Variable	Coefficient (standard errors are shown in parentheses)
Exam point, Unified state exam	0,1986 (0,1332)
Web of Science citations at 100 STS	0,0014 (0,001)
RISC publications on 100 STS	0,0094* (0,0045)
The share of defended STS for the reporting year	-1,755** (0,6257)
Number of scientific journals	0,3655* (0,1777)
Share of foreign students (except CIS)	0,3991 (0,5225)
Share of Foreign STS	-0,7631 (0,4658)
The ratio of the average salary of STS to the average salary of the region	0,0481* (0,021)
Graduated STS	0,0397 (0,1702)
The percentage of full-time faculty	-0,094 (0,1562)
Constant	18,8797 (18,5439)

Panel Regression with Fixed Effects:
** Significant by 5%.*
*** Significantly 1%.*

Four variables turned out to be significant at a 5% significance level: RSCI publications per 100 STS (direct correlation), the proportion of STS defenders for the reporting year (inverse correlation), the number of scientific journals (direct correlation) and the ratio of the average STS salary to the average salary in the region (direct correlation).

The proven relationship between the share of extra-budgetary revenues and the number of publications of the RSCI per 100 STS may be related to the positive impact of scientific productivity on the share of extra-budgetary income. At the same time, it was somewhat unexpected that the indicator of the number of publications of the RSCI turned out to be significant, and not the indicator of the number of publications or the number of citations in the international database – WoS. Recall that due to the multicollinearity problem, only the index of the number of citations in WoS was included in the final model. This process can be explained by the fact that the number of publications of the RSCI is better associated with the university's ability to generate its income. In particular, authors from those subject areas that are associated with obtaining the largest extrabudgetary income may be more likely to publish in the RSCI. For example, universities specializing in economics and management have higher contractual acceptance. It is also worth noting that, although the number of citations in WoS was not statistically significant, the coefficient is positive and quite close to significance (p-value = 0.147). This fact may serve, albeit not very reliable, but as an argument in favour of a positive relationship between the share of extra-budgetary revenues and the number of citations.

The proven negative correlation between the share of extra-budgetary revenues and the share of the defenses of STS dissertations in the current year is curious. Moreover, this indicator has the highest statistical significance. The efforts that the university directs to the successful defenses of its employees have a certain negative impact on the university's ability to receive extrabudgetary income. This conclusion is combined with the ideas that, with active development, it is more profitable and faster to attract outside staff than to grow own. At the same time, this result should not be taken as evidence that universities with high protection rates always have a low share of extrabudgetary funds – especiallly since the correlation coefficient between these indicators is almost zero (Table 5). A negative relationship is observed, taking into account the panel data structure with fixed values of all other variables of the model.

The number of scientific journals is directly related to the share of extra-budgetary revenues. An increase in publishing activity may be evidence of aspirations to concentrate on regional or national scientific activity, which may positively affect R&D income and grants. However, it is also possible because a large number of journals, so far at Russian universities, are related to the social and humanitarian sphere and management sciences, which are characterized by a high share of extra-budgetary income in educational activities.

The share of foreign STS is quite close to significance at the 10% level (p-value = 0.104). Even though this result is not highly reliable, a negative relationship with the share of extra-budgetary revenues is curious. This circumstance is probably because foreign STSs are one of the factors for increasing budget financing (it is fair to say that they are also its consequence).

Finally, the ratio of STS average wages to region average wages is also directly related. If we do not consider the possible difficulties of cause-and-effect relationships, then we can assume that high wages attract qualified and motivated employees, more inclined to scientific work, R&D and patent activity.

At the same time, many variables are very far from statistical significance; these are the share of international students, the share of STS with a scientific degree, and the share of full-time faculty members.

CONCLUSION

The study showed that all Russian universities are aimed at increasing the share of extra-budgetary revenues, and most of them successfully implement this goal. At the same time, the main successes of universities in improving this indicator in recent years are associated with the "low base effect", which may indicate that further growth will be more difficult. In this regard, the question arises of mechanisms that can directly or indirectly lead to an increase in the financial independence of universities.

This study is aimed not at studying the direct components of extrabudgetary income. The leading issue of this paper is studying the relationship between the main characteristics of the scientific and educational activities of the university and its share of extrabudgetary income. In our opinion, from a practical point of view, these relationships should be taken into account in the strategic and long-term planning of the development of the university.

The regression analysis revealed the university's indicators, the impact on which can be combined, and in the long run, directly or indirectly affect the share of its extra-budgetary incomes. When planning a university's scientific activity, firstly, the number and quality of publications, including not only international but also Russian ones, should be increased, this can go well with the increase in the share of extrabudgetary funds. Secondly, it should be borne in mind that the focus on high rates of defenses of dissertations can adversely affect the share of extra-budgetary income of the university, at least in the medium term. A rather interesting further direction of the study is to study the same relationship in the long run – there the result may be the opposite. Thirdly, it makes sense to pay attention to the activity models of universities with a large number of journals; they have a high share of extrabudgetary revenues. Fourth, a high salary should be planned for STS, which can positively affect the appearance of qualified and motivated employees with the skills and willingness to engage in research and development and patent activity.

In our opinion, these findings can be used by the university regulator, the Ministry of Science and Higher Education, in the preparation of tender documentation for the right to receive support for university development programs.

This analysis can be expanded by adding variables from sources other than Monitoring the effectiveness of universities. Presumably, the mechanisms that affect the amount of extrabudgetary revenues differ in different regions and different subject areas. Thus, a promising direction in the development of research is to take into account regional characteristics and various subject areas in which universities specialize.

REFERENCES

1. Azoulay P., Ding W., & Stuart T. (2007). The determinants of faculty patenting behavior: Demographics or opportunities? *Journal of economic behavior & organization, 63* (4), 599–623.
2. Breschi S., Lissoni F., & Montobbio F. (2005). From publishing to patenting: Do productive scientists turn into academi inventors? *Revue d'йconomie industrielle, 110* (1), 75–102.
3. Calderini M., & Franzoni C. (2004). Is academic patenting detrimental to high quality research. *An empirical analysis of the relationship between scientific careers and patent applications.* Bocconi University: Cespri Working Paper, 162.
4. Czarnitzki D., Glдnzel W., & Hussinger, K. (2007). Patent and publication activities of German professors: an empirical assessment of their co-activity. *Research Evaluation, 16* (4), 311–319.
5. Farsi J., Modarresi M., Motavaseli M., & Salamzadeh A. (2014). Institutional factors affecting academic entrepreneurship: The case of university of Tehran. *Economic Analysis, 47* (1–2), 139–159.
6. Kirby D. A. (2006). Creating entrepreneurial universities in the UK: Applying entrepreneurship theory to practice. *The Journal of Technology Transfer, 31* (5), 599– 603.
7. Meyer M. (2006). Are patenting scientists the better scholars? An exploratory comparison of inventor-authors with their non-inventing peers in nano-science and technology. *Research Policy, 35* (10), 1646–1662.
8. Riviezzo A., Santos S. C., Licбn F., Napolitano M. R., & Fusco, F. (2019). European universities seeking entrepreneurial paths: the moderating effect of contextual variables on the entrepreneurial orientation-performance relationship. *Technological Forecasting and Social Change, 141*, 232–248.
9. Sandler D. G., Evsykova I. A., Bogantseva S. S., Melnik D. A., Sterkhov A. V., & Bondarchuk D. V. (2019). Usage of integrated indicators in the implementation of programs to improve competitiveness in the context of developing cooperation with the industry and improving the economic sustainability of universities. *Russian Journal of Industrial Economics*, p. 341-355. (In Russ.)
10. Shane S. A. (2004). Academic entrepreneurship: University spinoffs and wealth creation. Edward Elgar Publishing, UK/Northampton, MA, USA.
11. Stephan P. E., Gurmu S., Sumell A. J., & Black G. (2007). Who's patenting in the university? Evidence from the survey of doctorate recipients. *Econ. Innov. New Techn., 16* (2), 71–99.
12. Tanha D., Salamzadeh A., Allahian Z., & Salamzadeh Y. (2011). Commercialization of university research and innovations in Iran: obstacles and solutions. *Journal of Knowledge Management, Economics and Information Technology, 1* (7), 126–146.
13. Van Looy B., Callaert J., & Debackere K. (2006). Publication and patent behavior of

academic researchers: Conflicting, reinforcing or merely co-existing? *Research policy, 35* (4), 596–608.
14. Van Looy B., Landoni P., Callaert J., Van Pottelsberghe B., Sapsalis E., & Debackere K. (2011). Entrepreneurial effectiveness of European universities: An empirical assessment of antecedents and trade-offs. *Research Policy, 40* (4), 553–564.
15. Wright M., Clarysse B., Mustar P. and Lockett A. (2007) *Academic Entrepreneurship in Europe*. Edward Elgar Publishing, Massachusetts, USA.

INFORMATION ABOUT THE AUTHORS

1. **Daniil G. Sandler** (Russia, Ekaterinburg) – PhD in Economic Sciences, Associate Professor of the Department of Financial Management, Leading Researcher, Research Laboratory for University Development Issues, Vice-Rector (Economics and Strategy). Ural Federal University named after the First President of Russia B. N. Yeltsin. E-mail: d.g.sandler@urfu.ru. Scopus ID: 56581474400
2. **Dmitry A. Gladyrev** (Russia, Ekaterinburg) – Senior Lecturer at Department of Economics. Ural Federal University named after the First President of Russia B. N. Yeltsin. E-mail: d.a.gladyrev@urfu.ru. Scopus ID: 57208191401

Accepted: Jun 1, 2020 | Published: Jul 1, 2020
Available: https://statecounsellor.wordpress.com/022020-2/