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BRIDGING THE KNOWLEDGE GAP BETWEEN SCIENCE AND INDUSTRY: EMPIRICAL RESEARCH OF UNIVERSITY OF NOVI SAD AND UNIVERSITY OF BELGRADE

Abstract: The paper presents results of the research of academic engagement activities among scholars in the Republic of Serbia at two largest and most influential universities. Comparison of academic engagement activities at University of Novi Sad (UNS) and University of Belgrade (UB) was based on the questionnaire that was sent to 3.163 scholars, and the analysis was carried out on the answers of 184 respondents. The included academic engagement activities are ranked according to the degree of potential for commercialization; starting from the publication of scientific papers in domestic and foreign journals, through participation in conferences and lectures, and up to higher levels in relation to the potential for commercialization of knowledge, such as consulting, selling products of a research without establishing a firm, licensing of patents, and establishing a spin-off. Potential differences in type of academic engagement were tested. A statistically significant difference was found between respondents from the University of Novi Sad and the University of Belgrade in relation to the mean values calculated for three types of academic engagement activities: publishing papers in international journals, selling products of their research without establishing a firm, and establishing a spin- off (new business). Respondents from University of Belgrade were statistically significantly ahead in the number of published works and sales of products or services without establishing companies, while respondents from University of Novi Sad showed a statistically significant advantage in entrepreneurial activity and the most significant form of commercialization of knowledge. Results obtained through this research of academic engagement activities show that researchers at the University of Novi Sad and University of Belgrade universities are significantly bridging the knowledge gap between universities and industry through the commercialization of academic knowledge.

Keywords: academic engagement activities, commercializing university knowledge

1. INTRODUCTION

The knowledge economy is based on the premise that in the global economy, knowledge is a crucial strategic resource, and learning is a basic competitive activity. In academic discourse, as well as in the field of politics, the terms knowledge economy and learning economy are used as synonyms, although the knowledge economy prevails because it is more often emphasized in the OECD countries and in the definitions of American authors, while the learning economy is still present in traces among Nordic authors. Fascination with the great success of high-tech companies in

recent decades has led to the fact that activities that require intensive use of knowledge and innovation are associated with companies from the information and communication sector. Research and development (R&D) activities are inextricably linked to knowledge acquisition and innovation. Depending on the definition of the economy as one based on knowledge or learning, it also depends on the approach to innovation, which is an indisputable source of competitive advantage in the global economy. Learning economy perceives innovation as an interactive learning process, which is socially and territorially embedded, and culturally and institutionally shaped (Lundvall and Borrás, 1997).
Each university cooperates with its environment in different ways. They are expected to fulfill their traditional mission of education and research, and additionally to contribute to the development of the economy, society, and culture in the region they belong to (Cirella and Murphy, 2022). The role of modern universities is multifaceted (Bishop, D'Este & Neely, 2011; Etzkowitz et al., 2000; Goddard et al., 2016; Hvide & Jones, 2016; Thomas & Pugh, 2020) and encompasses teaching, research, and entrepreneurship functions (Audretsch, 2014). Universities are changing, implementing new activities, and accepting practices that make them more entrepreneurial (Siegel & Wright, 2015; Cunningham & Link, 2015). Research commercialization requires building a strong external partnerships with ecosystem stakeholders, such as entrepreneurs, universities, local and national governments and private industries (Acs, Autio & Szerb, 2014; Bozeman & Gaughan, 2007).
Mechanisms of university knowledge transfer, as well as resulting financial compensation are subjects of research, and attract a lot of attention from both researchers and policy makers in developed (Kalar & Antoncic, 2015) and developing economies (Marozau & Guerrero, 2016).

2. ACADEMIC ENGAGEMENT

Universities are recognized as basic generators of knowledge and as such occupy a special place in modern society. Adding to them a third mission in the form of technological transfer, it becomes increasingly important to measure the contribution of universities to economic growth. The commercialization of academic knowledge, which includes the patenting and licensing of inventions, as well as academic entrepreneurship (Lockett, Wright & Franklin, 2003; Di Gregorio & Shane, 2003), is becoming an increasingly important research field, both for academia and policy makers. Commercialization represents a basic example of generating academic impact, as it represents an immediate and measurable market confirmation of the acceptance of the results of academic research (Markman, Siegel & Wright, 2008). It represents the basic and most important form of contribution of the academic community to society and the economy. A broader term than commercialization represents academic engagement which implies a way of transferring university knowledge, so it could be defined as scientifically based cooperation between academic and non-academic organizations (Perkmann & Walsh, 2007).
Collaboration can be formally defined as: joint research, contract research, consulting, informal counseling, or networking with associates. After establishing cooperation and academic engagement, commercialization in the form of academic entrepreneurship could follow (Würmseher, 2017) with the aim of commercializing a patent, invention, or unprotected expertise, in the form of university spin-offs, spin-outs, or start-up companies. This definition of commercialization emphasizes academic engagement with the sole purpose of financial gain, and that is why commercialization is a narrower, more precise term (Petrov, 2022).
Academic engagement, with all its nuances and aspects, is unfortunately driven solely by the personal motives of scientists. Motivating researchers at universities to work on commercialization of scientific research is a particularly important issue for the establishment of entrepreneurially oriented universities that would integrate much easier into various types of partnerships with the economy, i.e. innovation systems.
The most common barriers to the commercialization of scientific research are: overload of teaching and administrative work related to teaching, as well as the absence of the impact of commercialization on the academic career both for researchers and teachers. Therefore, commercialization is most often seen as a burden and an unnecessary waste of time, with a misunderstanding of the value of the potential market application of research for society. On the other hand, there is also a fear that active engagement in commercialization will slow scientists down in their academic work (Van Looy et al. 2004).
Academic engagement does not only depend on personal affinities and individual factors influencing scientists, but also on organizational and institutional factors. The existence of a technology transfer office, as well as the skills and experience of its employees, greatly facilitate commercialization at universities. In addition, the organizational climate, the presence of successful examples of academic startups and the proximity of business incubators, technology parks and similar supporting institutions influence academic engagement. On the other hand, academic engagement affects not only the scientific, but also the teaching results of scientific researchers (Petrov, 2022). In the 21st century, when the personal characteristics and motives of students are changing, it is imperative to demonstrate the applicability of the knowledge offered. Academic engagement leaves the opportunity for engaged teachers to make their teaching more interesting, down-to-earth and thereby popularize their subjects, modules and profiles.
At the individual level, scientists who have achieved success in scientific circles and are well connected engage in academic engagement. Most often, these are employees in higher scientific and teaching positions, with significant social capital, greater engagement in projects, more approved grants and more scientific publications, who are

considered experts in their fields, and consequently with better connections with the economy. Research has confirmed that there is a positive correlation between academic engagement and received grants, i.e. academic engagement and scientific production (Parkmann et al., 2013), which only confirms that academic engagement and academic progress are realized in parallel.
The practice of academic engagement is present and concentrated in cities with universities and with a traditionally strong industrial base such as Belgrade, Novi Sad, and Niš in the Republic of Serbia, although it is sporadic and based on personal contacts and initiatives. Formalized and structurally defined cooperation between state scientific research organizations and the private sector has been absent in the Republic of Serbia. The traditional cooperation between universities and the industry has also led to a regional concentration of researchers. It has been shown that the research sector lacks a critical mass of human potential, except around Belgrade and Novi Sad (Government of the Republic of Serbia, 2020).
This paper presents academic engagement activity among scholars at two most influential universities in the Republic of Serbia, University of Belgrade and University of Novi Sad. Academic engagement activities considered for this research were:

- Number of research papers published in Serbian journals in last 5 years;
- Number of research papers published in international journals in last 5 years;
- Honorarium for conferences, lectures;
- Consulting, mentoring, coaching;
- Selling products of your research without establishing a firm;
- Licensing of patents;
- Establishing a spin-off (new business).

Listed academic engagement activities are ranked according to the degree of commercialization potential, from the publication of scientific papers in domestic and foreign journals, which don't necessarily have any connection with the economy or the application of research, through participation in conferences and lectures, which may or may not bring any compensation for the researcher. A slightly higher level of knowledge commercialization potential is represented by consulting, which must have some connection with the economy, and is closer to the application of research knowledge than the publication of scientific papers. A special group of academic engagement activities, which are the closest to commercialization and which imply earning from the application of knowledge, include: selling products of your research without establishing a firm, licensing of patents, and establishing a spin-off (new business).
The aim of this paper is to analyze the statistically significant differences between respondents from the University of Novi Sad (UNS) and the University of Belgrade (UB) when it comes to the above mentioned academic engagement activities.

3. RESEARCH METHODOLOGY

3.1. Instrument

For this research, we used a survey instrument (Belitski et al., 2019) previously applied in transitional, i.e. post-socialist and developing economies: Belarus, Kazakhstan, and Azerbaijan. The same instrument was applied in a research conducted in the Republic of Serbia (Petrov et al., 2022).
The instrument itself consists of 3 parts. The first part includes general information about the respondents, such as: age, work experience, title, position, research field, faculty, and university. The second block of questions is devoted to the academic progress in terms of number of works published in Serbian or international journals in the last 5 years. The third part of the questionnaire is dedicated to the academic engagement of researchers, in the form of undertaking some of the following activities:

- Honorarium for conferences, lectures, etc.;
- Consulting, mentoring, coaching;
- Selling products of your research without establishing a firm;
- Licensing of patents;
- Establishing a spin-off (new business).

The empirical analysis is based on a dataset collected via online survey over the four months from September 2018 to January 2019 in the Republic of Serbia.

3.2. Sample

In our analysis, we first devoted our efforts to obtaining contact information of scholars from two most influential universities in the Republic of Serbia. There were 3,163 established scholars found via the universities' web-pages. In total 956 questionnaires were opened, and 266 responses were received, which represents response rate of 27.82%. Of

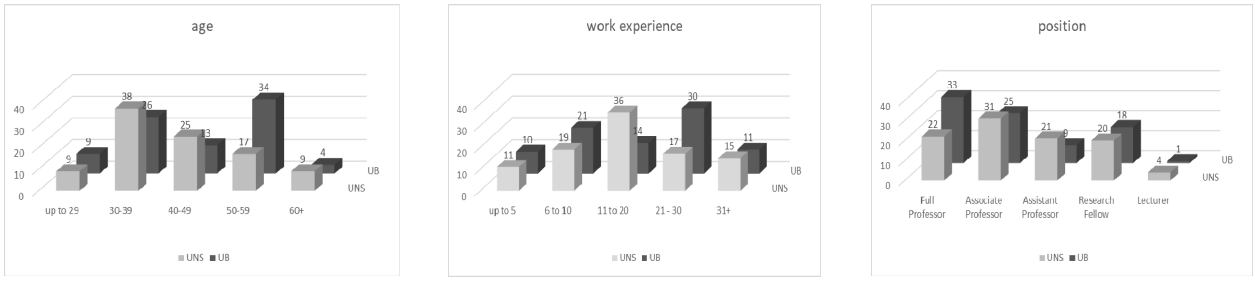
the 266 received responses, 41 had to be rejected as incomplete, because it was not stated which university the respondent was from.
Out of 225 valid answers, 115 respondents were from the University of Novi Sad, and 110 from the University of Belgrade. Out of 115 respondents from the University of Novi Sad, 17 respondents (representing 14.78% of respondents from UNS) did not report any type of academic engagement activities, while that number for respondents from the University of Belgrade was 24 (representing 21.82% of respondents from UB).
That left us with subsample of 184 respondents who reported some academic entrepreneurial activity. An overview of the demographic characteristics of the respondents is presented in Table 1.

Table 1: Demographics of the sample

Characteristics		UNS	UB	total	%
Age	up to 29	9	9	18	9.78%
	30-39	38	26	64	34.78%
	40-49	25	13	38	20.65%
	50-59	17	34	51	27.72%
	60+	9	4	13	7.07%
Work experience	up to 5	11	10	21	11.41%
	6 - 10	19	21	40	21.74%
	11 - 20	36	14	50	27.17%
	21 - 30	17	30	47	25.54%
	31+	15	11	26	14.13%
Title	PhD	78	69	147	79.89%
	MS	16	14	30	16.30%
	MSc	4	3	7	3.80%
Position	Full Professor	22	33	55	29.89%
	Associate Professor	31	25	56	30.43%
	Assistant Professor	21	9	30	16.30%
	Research Fellow	20	18	38	20.65%
	Lecturer	4	1	5	2.72%
Total Sample Size (n) = 184					

Source: Authors

In relation to the age the predominant number of respondents, 64 of them (34.78%) were in 30 to 39 years interval, followed by 51 of them (27.79%) in 50 to 59 years interval, and by 38 respondents (20.65%) that were between 40 to 49 years of age. The youngest and the oldest scholars are much less represented, with 9.78% and 7.07% respectively.



Picture 1: Demographic characteristics of survey respondents from UNS and UB
Source: Authors

In terms of the work experience, the distribution was as follows: 50 of respondents (27.17%) had between 11 and 20 years of experience, 47 (25.54%) between 21 and 30 years, 40 (21.74%) between 6 and 10 years, while the groups with 31+ and up to 5 years of work experience were much less represented, with 14.13% and 11.41% respectively.
The most represented academic title by far in our sample was PhD with 147 (79.89%), followed by MS with 30 (16.3%) and MSc 7 (3.8%). Most of the respondents held teaching positions - 141 (full professor 29.89%, associate professor 30.43% and assistant professor 16.30%), followed by research fellow - 38 (20.65%), and lecturer - 5 (2.72%). Characteristics of the sample are presented in Table 1 and Picture 1.

4. RESEARCH RESULTS

For this research, the difference in the degree of academic engagement activities of employees at the two largest universities in the Republic of Serbia was tested. Potential differences in the type of academic engagement were also tested. Levene's test was used to test if samples have equal variances. The results of the t-test are shown in Table 2.

Table 2: Results of independent t-test for two samples

Academic Engagement	t statistics	df	p
Papers published in Serbian journals	.344	180	.731
Papers published in international journals	-2.018	157.783	.045
Honorarium for conferences, lectures, etc.	.513	182	.609
Consulting, mentoring, coaching	1.099	182	.273
Selling products of your research without establishing a firm	-1.767	173.062	.079
Licensing of patents	-.194	182	.846
Establishing a spin-off (new business)	1.866	172.308	.064

Source: Authors

A statistically significant differences were found between the respondents from the University of Novi Sad and the University of Belgrade in relation to the mean values calculated for three types of academic engagement activities:

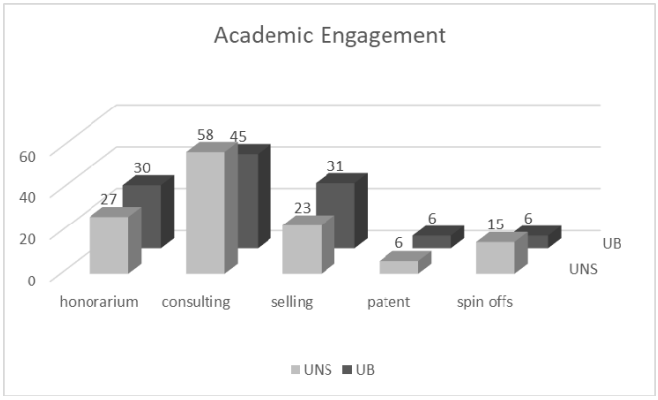
- Papers published in international journals (t=-2.018, df=157.783, p<0.05),
- Selling products of research without establishing a firm (t=-1.767, df=173.062, p<0.1), and
- Establishing a spin-off (new business) (t=1.866, df=172.308, p<0.1).

For these three types of academic engagement, the variance homogeneity test indicated that equal variance was not assumed (F=6.764, p=0.010; F=12.69, p=0.001; F=14.481, p=0.00 respectively).

For the variable Papers published in international journals a statistically significant difference was confirmed with a confidence level of 95%. Figure 2 presents distribution of respondents with publications of more than 20 papers in international magazines, at the various faculties of the University of Novi Sad and the University of Belgrade.

Picture 2: Number of researchers reporting the highest production of papers in international journals (more than 20 in 5 year period)
Source: Authors

A statistically significant difference, with a confidence level of 90%, was confirmed for the variables Selling products of your research without establishing a firm (t=-1.767, df=173.062, p<0.1), and Establishing a spin-off (new business) (t= 1.866, df=172.308, p<0.1), see Table 2.



Picture 3: Reported academic engagement at University of Novi Sad and University of Belgrade
Source: Authors

Picture 3 presents distribution of frequencies for types of academic engagement activities at University of Novi Sad and University of Belgrade. Consulting, mentoring, coaching is the most represented activity at both universities. Next at University of Belgrade, almost evenly represented are Selling products of your research without establishing a firm, and Honorarium for conferences, lectures. At University of Novi Sad Honorarium for conferences, lectures is slightly more represented compared to Selling products of your research without establishing a firm. The most important activity, from the aspect of commercialization, Establishing a spin-off (new business), is more represented at University of Novi Sad than at University of Belgrade, and that difference was confirmed by the t-test as statistically significant. The number of reported patents was equal at both universities.

5. CONCLUSION

In the subsample of respondents who reported some kind of academic engagement activities and were from University of Novi Sad, the majority were between 30 and 39 years of age, held the title of Associate Professor, and had 11 to 20 years of work experience. The typical profile of respondents from University of Belgrade who reported some type of academic engagement activities was: 50 to 59 years of age, with the title of Full Professor, and 30 to 39 years of work experience (Picture 1).

A statistically significant difference between respondents from University of Novi Sad and University of Belgrade (Table 2) was determined at the 95% confidence level for the variable Papers published in international journals, which was expected given that University of Belgrade was ranked in the 401-500 interval on the Academic Ranking of World Universities, while University of Novi Sad was ranked in 901 to 1000 range.

A statistically significant difference between respondents from University of Novi Sad and University of Belgrade (Table 2) was determined at the 90% confidence level for the variable Selling products of your research without establishing a firm, where 31 respondents were from University of Belgrade, and 23 from University of Novi Sad. With the same level of reliability, a statistically significant difference was found between respondents from University of Novi Sad and University of Belgrade (Table 2) for the variable Establishing a spin-off (new business), whereby 15 respondents from University of Novi Sad established a spin-off, while only 6 respondents from University of Belgrade did so.

Respondents from University of Belgrade were statistically significantly ahead in the number of published works and sales of products or services without establishing companies, while respondents from University of Novi Sad had a statistically significant advantage in entrepreneurial activity and the most significant form of commercialization of knowledge.

The results of this analysis of academic engagement activities, demonstrate that the activities of researchers at the universities of University of Novi Sad and University of Belgrade are significantly bridging the knowledge gap between science and industry through the commercialization of academic knowledge.

The limitation of this research is reflected in the structure of the sample in relation to the distribution of respondents by faculties, i.e. the number of respondents is not evenly distributed among scientific fields.

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