Yugoslav Journal of Operations Research
24 (2014), Number 3, 415-427
DOI: 10.2298/YJOR131112005K

SCIENTIFIC RESEARCH PUBLICATION PRODUCTIVITY IN THE AREAS OF MATHEMATICS AND PHYSICS IN SOUTH EASTERN EUROPE

Đuro KUTLAČA

Institute Mihajlo Pupin, University of Belgrade, Serbia
djuro.kutlaca@pupin.rs

Lazar ŽIVKOVIĆ

Institute Mihajlo Pupin, University of Belgrade, Serbia
lazar.zivkovic@pupin.rs

Dijana ŠTRBAC

Institute Mihajlo Pupin, University of Belgrade, Serbia
dijana.strbac@pupin.rs

Dragan BABIĆ

Vinča Institute of Nuclear Sciences, University of Belgrade, Serbia
dbabic@vinca.rs

Dušica SEMENČENKO

Institute Mihajlo Pupin, University of Belgrade, Serbia
dusica.semencenko@pupin.rs

Received: November 2013 / Accepted: January 2014

Abstract: The paper presents the scientific publication productivity, registered in Web of Science (WoS) databases in two fields of science, Mathematics and Physics, for authors from countries of South East Europe (SEE).Using Revealed Publication Advantage (RPA) indicator calculated for SEE countries, policy makers could get insight into the scientific publication productivity of SEE countries, in these two scientific fields, compared with the world average. The scientific output in Mathematics and Physics from the SEE region represents majority of the overall scientific output in every particular country in this region. The scientific output in Mathematics and Physics from the SEE region is comparable with those of other research groups in the world. When analysing Web of Science publications by field of research, Mathematics represents 2.1% of the total worldwide scientific production, while Physics accounts for 8.8%, giving a total of

10.9% for Physics and Mathematics combined – over 1,547,187 publications in the period 2005-2010. In South East Europe, Mathematics is 3.5% of the total scientific production, while Physics is 9.6% - bringing the total for Physics and Mathematics to 13.1%.

Keywords: Scientific publication productivity, Web of Science, Revealed Publication Advantage (RPA) indicator, South East Europe (SEE), Mathematics, Physics.

MSC: 62P25, 62Q05, 62P35.

1. INTRODUCTION

The Web of Science (WoS) is a powerful set of scientific bibliographic databases which enable detailed analysis of scientific publication productivity such as performance and research capacity of individual researchers, research teams, institutions and national research systems in specific fields of sciences or in science in general. This is additional benefit that WoS offers in parallel to its primary objective which is to facilitate researchers with easy literature search and access to publications of interest. Web of Science, as an online academic citation index provided by Thomson Reuters, contains three citation indexes subscribed since 1996, two section of the conference proceedings subscribed since 2001 and two sections of the journal citations report subscribed since 2006. Multidisciplinary content covers more than 12,000 journals with the highest impact worldwide, including Open Access journals and over 150,000 conference proceedings.

The analysis of scientific publication productivity is part of the activities undertaken by Science and Technology Policy Research Centre of "Mihajlo Pupin" Institute aiming to support decision making process in governance of science and technology (S&T). Within this work, the scientific publication production registered in the WoS databases in the areas of Mathematics and Physics is analysed for the countries of South East Europe (SEE). This information gives the insight to the balance between these scientific fields in the SEE countries compared with the world average, and also reveals which scientific field is dominant in each country. In order to understand the specific focus on R&D specialization in one country or region, the concept of relative specialization is developed, based on the concept of economic specialization which was initially introduced in trade theory by the so-called "Balassa index" of "Revealed Comparative Advantage" (RCA) [1]. The indicator, constructed in analogy to the RCA, is so-called "Revealed Patent/Publication Advantage" (RPA), and represents the basic concept of the relative specialization used in this paper [2, page 4]. To make the comparison, we used RPA indicator which allows the assessment of the relative position of an S&T field in a specific country while eliminating size effects.

One of our key hypotheses is that there is a critical mass of researchers in the South Eastern Europe with significant potential and capacity for fundamental and applied research; this is valid in particular for Mathematics and Physics.

2. METHODOLOGY

There is a great number of methods and techniques developed to analyse scientific research publication productivity and research capacity of individual researchers, research teams, institutions and national research systems [3:28-29]. In order to understand the specific focus on R&D specialization in one country or region, the concept of relative specialization is developed, based on the concept of economic specialization, initially introduced in trade theory. Balassa introduced the so-called "Balassa index" of "Revealed Comparative Advantage" (RCA) which measures relative export performance of a country and industry, defined as a product world exports share of a country divided by its share of total world exports. Revealed comparative advantage indices (RCA) use the trade pattern to identify the sectors in which an economy has advantage by comparing trade profile of the country of interest with the world average. It defines the pattern in comparative advantage by using the trade flows. Since this pattern in comparative advantage is revealed by the observed pattern of trade flows, it is therefore called 'revealed comparative advantage'. This RCA indicator has also found a place in innovation economics, i.e., by analysing a country's shares in patents by patent classes (measuring technological specialization), and publication shares by fields and countries (scientific specialization) compared with global numbers. Constructed in analogy to the RCA, indicator is therefore entitled "Revealed Patent/Publication Advantage" (RPA), and it represents the concept behind the relative specialization used in this paper. However, while trade of goods is connected to economies' comparative advantages, the RPA is not a direct measure of economic comparative advantage, while patents and publications are. The RPA thus reveals changes in the stock of technological/scientific knowledge in a given period or between periods. Technological and scientific knowledge are both cumulative, although older knowledge often becomes obsolete; therefore, the RPA does not measure the stock of technological knowledge but rather gains or losses [2: 5-7]. The use of these indicators leads to so-called 'relative specialization profiles' or 'matrices' which provide information about a country's relative performance, and relative comparative advantage.

The RCA index is defined as the ratio of two shares. The numerator is the share of a commodity of interest total export compared with the country's total exports. The denominator is a share of the world export of the same commodity compared with total world exports. RCA takes a value between zero and positive infinity. A country is said to have a revealed comparative advantage if the value exceeds unity. A country therefore has a revealed comparative advantage only in those products for which its market share of the world exports is above its average share of world exports. Interpretation of the Balassa Index (BI) could be threefold: (1) index provides a demarcation between countries that reveal a comparative advantage in a particular sector, and those countries that do not; (2) it quantifies the sector-specific degree of comparative advantage enjoyed by one country with respect to any other country or set of countries; and (3) the index generates possible cross-country (with respect to a sector) or cross-sector (inside a country) rankings, ordered according to the specific value of BI.

As a parameter for determining relative publication specialization, the Revealed Publication Advantage (RPA) according to Balassa's formula has the following definition:

$$RPA_{k,i} = 10_0 x \tanh 1_n \left\{ \frac{\frac{P_{k,i}}{\Sigma_i P_k}}{\frac{\Sigma_k P_{k,i}}{\Sigma_k, iP_{k,i}}} \right\} \quad (1)$$

with $P_{k,i}$ indicating the amount of publications of a country **k** in the S&T field **i**.[1] The logarithmic transformation centres the data around zero and the hyperbolic tangent multiplied by 100, limits the RPA values to a range of +100 to -100. Positive values for S&T field **i** point to the fact that the field has a higher weight in the portfolio of the country than its weight in the world (all publications from all countries taken together). Negative values indicate specialization of P below the average, respectively. Values around zero – negative as well as positive – are distinguished from a positive or negative specialization and labelled 'as expected' or 'world average'. The RPA indicator allows the assessment of the relative position of an S&T field in a specific country while eliminating size effects. The size of the field and the size of the country are standardized in this indicator, as relative shares are used. Therefore, it is possible to directly compare countries and fields. However, the standardization itself is highly affected by low absolute numbers, which means by random effects. Therefore, the profiles of countries with low absolute totals require careful interpretation [2, page 6].

Specialization indices are of interest for policy makers as they appear to show strengths and weaknesses clearly. However, any interpretation needs to take several factors into account: a positive (or negative) specialization in a given S&T field **i** for country **k** does not suggest whether this country plays an important role in this field or not, since size effects (small or big absolute number of publications) have been eliminated. In short, while the calculation method used reveals 'comparative advantages' of countries, the degree of comparative advantage cannot be deduced from the analyses: any policy conclusion, let alone policy initiative, needs to take account of information on absolute figures and trends. Therefore, it is more appropriate for policy analysis and conclusions to compare like with like – i.e., countries of relatively similar economic size, or to have a look at a particular technology and focus on the main competitors [2: 7].

Relative publication specialization should be considered as a starting point when exploring scientific productivity of a certain country or a region. In order to be used for policy conclusions and initiatives, it has to be combined with absolute data as well as with indicators of scientific publication quality. RPA is an index that shows in which fields some country has scientific production above or below world average but it does not explain the quality of scientific production. This indicator does not include data about citations, and this is the reason why RPA has to be used with caution and in addition to other indices.

For example, if we observe scientific field *Physic mathematical* in Serbia and Romania, we will conclude that in both countries publication productivity is above world average (RPA of Serbia is 51.4 and of Romania is 52.1). Although absolute values of RPA indicators are very similar, they cannot be compared in terms of conclusion that these two countries have similar development of this scientific field. Data on number of

[1] Adapted from Balassa, B., „Trade Liberalisation and "Revealed" Comparative Advantage". The Manchester School, 33: 99–123. (1965).

papers in this field show 223 papers in Serbia, and 540 in Romania. This information should be suplemented with citation analysis that whould show quality of scientific publications in Serbia and Romania, and then it could be used for comparing two countries.

For more than 40 years, the Institute for Scientific Information (now part of Thomson Reuters) has produced the only available database making possible citation analysis - Web of Science. In 2004 Elsevier has launched its own bibliographic database - Scopus. With over 19,000 titles from more than 5,000 international publishers, SciVerse Scopus offers researchers a quick, easy and comprehensive resource to support their research needs in the scientific, technical, medical and social sciences fields and, more recently, also in the arts and humanities. It has about 49 million records including: 19,500 peer-reviewed journals (including 1,900 Open Access journals), 400 trade publications, 360 book series, "Articles-in-Press" from over 3,850 journals [4].

Comparison of citation databases has been the subject of a variety of studies using various bodies of research, and applied to various academic disciplines and subspecialties [5, page 371]. There are numerous studies that investigate WoS and Scopus advantages and disadvantages in terms of their depth of coverage, ease of use, scientific fields, etc. These two online citation databases complement each other because neither resource is all inclusive. Those who perform bibliometric analysis and comparisons of countries and fields of science must choose the data source on the basis of their individual needs. Since the aim of this study is to explore scientific productivity in two fields of science – Mathematics and Physics, Web of Science is more suitable for this kind of analysis. WoS classifies articles in more than 250 categories, while Scopus has only 27 scientific fields, so WoS enables more detailed insight in scientific fields of Mathematics and Physics.

Following the above methodological instructions, the total number of publications for all observed SEE countries in two selected scientific fields was obtained by summing up all the publications in subject area subcategories in each of the main subject areas, acquired through the search in WoS database (Table 2). The ratio between this number of publications in scientific fields and the total number of publications for the country was compared with the same ratio regarding world publication data.

3. RESULTS AND DISCUSSION

The search results obtained for the complete publication output ($P_{k,i}$) for the SEE countries (k) for the period from 2005 to 2010 has been summarized for the two scientific fields: Mathematics and Physics and given in Table 1. In table 2, same calculations are presented as totals for selected areas of Mathematics and Physics for SEE region, totals for Western Balkan countries (WBC) and for world total, as well as for Austria.

In this study Austria is considered as a control country. It is bordering the SEE region and is a member of EU since 1995. Austria's higly developed R&D sector is a goal that all SEE countries are striving to achieve, and this is why we use it as a benchmark for countries in the region. Having insight in which scientific fields Austria is particularly developed (RPA above the world average) will help decision makers to investigate policies, incentives and developing paths of those fields. Puting together scientific productivity of Austria, and SEE and WBC regions is also important for exploring common S&T priorities and finding ways for cooperation.

Table 1: Publication output ($P_{k,i}$) in SEE countries in selected fields of science, 2005-2010.

Web of science category	AL	BiH	CRO	MAC	MNE	SER	BG	GR	HU	RO	SI	TU
Mathematics applied	6	32	453	84	17	950	434	1540	921	2957	549	2459
Mathematics	8	34	456	30	24	704	360	932	1538	2028	695	1817
Mathematics interdiscip. applications	0	12	140	21	5	179	78	517	195	489	226	770
Statistics probability	0	1	30	16	1	70	30	506	215	114	57	426
Logic	0	0	0	0	0	4	0	0	0	3	1	3
Sum mathematics	**14**	**79**	**1079**	**151**	**47**	**1907**	**902**	**3495**	**2869**	**5591**	**1528**	**5475**
Sum mathematics (%)	**1.2%**	**2.2%**	**3.2%**	**2.4%**	**4.2%**	**5.4%**	**3.3%**	**2.5%**	**4.0%**	**6.6%**	**4.4%**	**2.4%**
Physics applied	45	21	317	105	28	726	1461	2628	1187	3631	644	2730
Physics multidisciplinary	41	27	371	63	46	697	817	1678	1049	2019	636	2018
Optics	0	45	176	48	1	427	908	1278	596	2574	198	1485
Physics condensed matter	3	8	263	35	10	362	516	1352	1064	1205	534	1706
Astronomy astrophysics	5	5	234	7	6	415	379	1319	777	263	282	720
Physics atomic molecular chemical	3	30	259	54	3	309	304	696	1114	394	297	499
Physics particles fields	3	9	243	4	43	162	378	1012	516	472	417	562
Physics mathematical	0	5	92	25	4	223	186	642	440	540	232	925
Physics nuclear	4	4	284	11	3	82	300	415	620	628	111	624
Crystallography	5	1	167	10	5	101	151	221	197	304	135	1376
Spectroscopy	5	2	128	23	2	102	183	329	371	245	208	583
Physics fluids plasmas	0	10	42	21	2	163	140	321	250	193	151	219
Acoustics	0	0	32	2	4	44	23	327	38	100	60	516
Microscopy	0	1	7	2	2	46	11	41	29	18	28	32
Sum physics	**114**	**168**	**2615**	**410**	**159**	**3859**	**5757**	**12259**	**8248**	**12586**	**3933**	**13995**
Sum physics (%)	**9.9%**	**4.6%**	**7.7%**	**6.6%**	**14.1%**	**11.0%**	**21.2%**	**8.7%**	**11.5%**	**14.9%**	**11.3%**	**6.2%**
Sum mathematics + physics (%)	**11.2%**	**6.8%**	**10.9%**	**9.0%**	**18.3%**	**16.4%**	**24.5%**	**11.1%**	**15.5%**	**21.5%**	**15.6%**	**8.6%**
Sum	**1146**	**3647**	**33995**	**6242**	**1124**	**35176**	**27201**	**141592**	**71693**	**84353**	**34934**	**227281**

Source:Data extracted from ISI Web of Science [6].

Legend: AL – Albania, BiH – Bosnia and Herzegovina, CRO – Croatia, MAC - Former Yugoslav Republic of Macedonia, MNE – Montenegro, SER – Serbia, BG – Bulgaria, GR – Greece, HU – Hungary, RO – Romania, SI – Slovenia, TU – Turkey.

Table 2: Publication output ($P_{k,i}$) in selected fields of science, 2005-2010.

Web of science category	**World**	**SEE**	**WBC**	*Austria*
Mathematics applied	144193	10402	1542	*1667*
Mathematics	126176	8626	1256	*1248*
Mathematics interdisciplinary applications	44710	2632	357	*427*
Statistics probability	51537	1466	118	*516*
Logic	159	11	4	*4*
Sum mathematics	**366775**	**23137**	**3277**	*3862*
Sum mathematics (%)	**2.1%**	**3.5%**	**4.0%**	*2.6%*
Physics applied	360330	13523	1242	*2648*
Physics multidisciplinary	197569	9462	1245	*1803*
Optics	234660	7736	697	*1475*
Physics condensed matter	175345	7058	681	*2024*
Astronomy astrophysics	115938	4412	672	*1653*
Physics atomic molecular chemical	89900	3962	658	*1251*
Physics particles fields	70589	3821	464	*734*
Physics mathematical	63013	3314	349	*580*
Physics nuclear	40852	3086	388	*451*
Crystallography	60294	2673	289	*369*
Spectroscopy	46815	2181	262	*549*
Physics fluids plasmas	45508	1512	238	*259*
Acoustics	39334	1146	82	*235*
Microscopy	7040	217	58	*159*
Sum physics	**1547187**	**64103**	**7325**	*14190*
Sum physics (%)	**8.8%**	**9.6%**	**9.0%**	*9.6%*
Sum mathematics + physics (%)	**10.9%**	**13.1%**	**13.0%**	*12.3%*
Sum	**17549649**	**668384**	**81330**	*147239*

Source: Data extracted from ISI Web of Science [6].

The appropriate RPAs calculated from the data in Tables 1 and 2 as described in chapter on methodology used in this paper are given in the Tables 3 and 4 for selected fields of sciences and for all SEE countries (Table 3) and regions (Table 4) studied.

Table 3: RPA indicator for SEE countries in selected fields of science, 2005-2010.

Web of Science category	AL	BiH	CRO	MAC	MNE	SER	BG	GR	HU	RO	SI	TU
Mathematics applied	-42.2	6.6	44.9	45.7	54.4	83.1	58.1	27.3	41.9	89.6	57.1	26.8
Mathematics	-2.9	25.4	55.4	-38.2	79.6	77.1	54.4	-8.8	79.8	83.6	76.9	10.6
Mathematics interdis.applications		25.0	44.6	27.1	50.6	59.9	11.8	34.5	6.5	67.6	73.1	27.8
Statistics probability		-98.3	-83.4	-13.5	-83.2	-37.1	-75.3	19.4	2.1	-65.0	-52.8	-42.1
Logic						98.7				87.8	81.8	35.9
Sum mathematics	**-49.1**	**3.6**	**39.5**	**14.5**	**60.0**	**74.1**	**43.1**	**16.5**	**57.1**	**81.9**	**62.8**	**14.1**
Physics applied	57.1	-85.4	-65.8	-19.7	19.1	0.5	74.5	-10.1	-21.2	62.9	-10.7	-49.0
Physics multidisciplinary	82.0	-39.6	-3.1	-10.9	85.9	51.2	75.4	5.1	25.6	63.8	44.7	-23.3
Optics		-8.0	-73.9	-50.3	-99.1	-9.6	72.3	-37.4	-44.2	67.8	-69.5	-61.5
Physics condensed matter	-87.2	-90.8	-25.0	-52.1	-11.6	3.0	56.6	-4.5	37.6	34.3	40.1	-27.8
Astronomy astrophysics	-39.3	-91.7	4.1	-94.4	-21.0	52.3	63.3	33.1	45.8	-63.6	19.8	-62.6
Physics atomic molecular chemical	-58.6	44.1	37.7	48.1	-57.3	49.2	65.3	-4.1	80.4	-9.2	46.7	-69.0
Physics particles fields	-40.5	-45.3	51.9	-95.0	97.8	13.5	84.5	51.9	52.4	31.9	79.6	-45.1
Physics mathematical		-74.6	-27.5	10.9	-0.9	51.4	56.8	22.9	49.0	52.1	54.8	12.5
Physics nuclear	38.4	-63.7	85.6	-27.1	13.6	0.1	91.5	22.6	86.5	82.2	30.1	16.4
Crystallography	23.5	-98.7	34.3	-64.3	25.3	-17.8	44.6	-65.8	-22.0	4.8	11.7	51.3
Spectroscopy	45.6	-91.9	33.2	31.2	-38.4	8.3	72.8	-13.7	58.0	8.5	66.6	-3.9
Physics fluids plasmas		5.6	-63.0	25.5	-36.0	52.3	59.5	-13.4	28.8	-12.5	47.1	-75.7
Acoustics			-70.0	-96.0	43.2	-52.5	-75.1	3.0	-89.4	-56.3	-26.0	1.3
Microscopy		-36.3	-58.3	-22.1	90.3	82.8	0.8	-31.5	0.8	-55.9	59.9	-78.1
Sum physics	**12.0**	**-57.1**	**-13.6**	**-28.6**	**44.0**	**21.5**	**70.4**	**-1.8**	**26.0**	**48.2**	**24.0**	**-34.4**
Sum mathematics + physics (%)	**2.4**	**-44.3**	**-0.4**	**-19.1**	**47.7**	**38.6**	**66.9**	**2.0**	**33.8**	**59.2**	**34.5**	**-23.7**
Sum	**1146**	**3647**	**33995**	**6242**	**1124**	**35176**	**27201**	**141592**	**71693**	**84353**	**34934**	**227281**

Legend: AL – Albania, BiH – Bosnia and Herzegovina, CRO – Croatia, MAC – Former Yugoslav Republic of Macedonia, MNE – Montenegro, SER – Serbia, BG – Bulgaria, GR – Greece, HU – Hungary, RO – Romania, SI – Slovenia, TU – Turkey.

Table 4: RPA indicator for selected fields of science, 2005-2010.

Web of Science category	SEE	WBC	*Austria*
Mathematics applied	56.4	68.4	*31.0*
Mathematics	52.6	64.4	*16.3*
Mathematics interdisciplinary applications	41.0	49.6	*12.9*
Statistics probability	-28.4	-60.8	*17.5*
Logic	53.5	93.4	
Sum mathematics	**46.6**	**57.6**	***22.3***
Physics applied	-1.5	-28.8	*-13.2*
Physics multidisciplinary	22.5	29.8	*8.4*
Optics	-14.3	-41.8	*-28.1*
Physics condensed matter	5.5	-17.5	*30.9*
Astronomy astrophysics	-0.1	22.0	*48.6*
Physics atomic molecular chemical	14.5	42.8	*46.7*
Physics particles fields	33.8	33.6	*21.1*
Physics mathematical	31.2	17.6	*9.2*
Physics nuclear	59.5	61.5	*26.8*
Crystallography	15.1	3.4	*-30.5*
Spectroscopy	19.9	18.6	*32.3*
Physics fluids plasmas	-13.6	12.0	*-37.0*
Acoustics	-26.2	-66.3	*-32.7*
Microscopy	-20.8	51.9	*75.7*
Sum physics	**8.4**	**2.1**	***8.9***
Sum mathematics + physics	**17.8**	**17.7**	***11.7***

Comparing publication productivity in the field of Mathematical sciences we can conclude the following:

- Mathematics applied: above the world average are Croatia, FYR of Macedonia, Montenegro, Serbia, Bulgaria, Greece, Hungary, Romania, Slovenia and Turkey - only Albania is under the world average in SEE region in this field of science! In total, the whole SEE region, as well as the WBC region, are above the world average, even more than researchers in this field in Austria are performing;
- Mathematics: above the world average are Croatia, FYR of Macedonia, Serbia, Bulgaria, Hungary, Romania, Slovenia and Turkey. In total, the whole SEE

region, as well as the WBC region, are above the world average, even more than researchers in this field in Austria are performing;

- Mathematics interdisciplinary applications: above the world average are Croatia, FYR of Macedonia, Montenegro, Serbia, Bulgaria, Greece, Hungary, Romania, Slovenia and Turkey - only there are no publications in this field from Albania! In total, the whole SEE region, as well as the WBC region, are above the world average, even more than researchers in this field in Austria are performing;
- Statistics probability: above the world average are only Hungary and Greece. In total, the whole SEE region, as well as the WBC region, are under the world average, even performing rather less efficient than researchers in this field in Austria.

Considering all sub fields of Mathematics in total, above the world average are Croatia, FYR of Macedonia, Montenegro, Serbia, Bulgaria, Greece, Hungary, Romania, Slovenia and Turkey - only Albania is under the world average in SEE region in this field of science! In total, the whole SEE region, as well as the WBC region, is above the world average, even more than researchers in this field in Austria are performing.

Comparing publication productivity in the field of Physical sciences we can conclude the following:

- Physics applied: above the world average are Albania, Montenegro, Serbia, Bulgaria and Romania. In total, the whole SEE region, as well as the WBC region, are under the world average, even performing less efficient than researchers in this field in Austria;
- Physics multidisciplinary: above the world average are Albania, Montenegro, Serbia, Bulgaria, Greece, Hungary, Romania and Slovenia. In total, the whole SEE region, as well as the WBC region, are above the world average, even more than researchers in this field in Austria are performing;
- Optics: above the world average are Bulgaria and Romania only. In total, the whole SEE region, as well as the WBC region, are below the world average, but still less efficient than researchers in this field in Austria;
- Physics condensed matter: above the world average are Serbia, Bulgaria, Romania, Slovenia and Hungary. In total, the whole WBC region is below the world average, while researchers in Austria are above the world average;
- Astronomy astrophysics: above the world average are Croatia, Serbia, Slovenia, Bulgaria, Greece, and Hungary. In total, the whole SEE region is around the world average, and the WBC region is above the world average. Both SEE and WBC regions are performing less efficient than researchers in this field in Austria;
- Physics atomic molecular chemical: above the world average are Croatia, FYR of Macedonia, Serbia, Bulgaria, Hungary and Slovenia. In total, the whole SEE region, as well as the WBC region, are above the world average, but still performing less efficient than researchers in this field in Austria;
- Physics particles fields: above the world average are Croatia, Montenegro, Serbia, Bulgaria, Greece, Hungary, Romania, and Slovenia. In total, the whole SEE region, as well as the WBC region, are above the world average, even more than researchers in this field in Austria are performing;
- Physics mathematical: above the world average are FYR of Macedonia, Serbia, Bulgaria, Greece, Hungary, Romania, Slovenia and Turkey. In total, the whole

SEE region, as well as the WBC region, are above the world average, even more than researchers in this field in Austria are performing;

- Physics nuclear: above the world average are Albania, Croatia, Montenegro, Serbia, Bulgaria, Greece, Hungary, Romania, Slovenia and Turkey. In total, the whole SEE region, as well as the WBC region, are above the world average, even more than researchers in this field in Austria are performing;
- Crystallography: above the world average are Albania, Croatia, Montenegro, Bulgaria, Romania, Slovenia and Turkey. In total, the whole SEE region, as well as the WBC region, are above the world average, even more than researchers in this field in Austria are performing;
- Spectroscopy: above the world average are Albania, Croatia, Serbia, FYR of Macedonia, Bulgaria, Hungary, Romania, and Slovenia. In total, the whole SEE region, as well as the WBC region, are above the world average, but still performing less efficient than researchers in this field in Austria;
- Physics fluids plasmas: above the world average are FYR Macedonia, Serbia, Bulgaria, Hungary, and Slovenia. In total, the whole SEE region is under the world average, and the WBC region is above the world average; but still both regions are better performing than researchers in this field in Austria;
- Acoustics: above the world average are Montenegro, Greece and Turkey. In total, the whole SEE region, as well as the WBC region, are under the world average, and the researchers in this field in Austria are performing equally;
- Microscopy: above the world average are Montenegro, Hungary, Slovenia, Serbia, and Bulgaria. In total, the whole SEE region is under the world average, and the WBC region is above the world average but still performing less efficient than researchers in this field in Austria.

Considering all sub fields of physics in total, above the world average are Albania, Montenegro, Serbia, Bulgaria, Hungary, Romania, Slovenia. In total, the whole SEE region, as well as the WBC region, is above the world average, but still performing less efficient than researchers in this field in Austria.

Considering all sub fields of mathematics and physics in total, above the world average are Albania, Montenegro, Serbia, Bulgaria, Greece, Hungary, Romania, and Slovenia. In total, the whole SEE region, as well as the WBC region, is above the world average, even more than researchers in this fields of sciences in Austria are performing.

Based on publication output data from this paper, field-specific excellence can be identified in broader regions where highly cited papers were published. Visualisation methods of spatial scientometrics allow revealing regions of excellence around the world using computer programs that are freely available [7].

4. CONCLUDING REMARKS

Revealed publication advantage is an indicator that gives information for making significant decisions regarding R&D policy in specific country or region. This is particularly important for developing countries which should choose priorities in science and technology, but also for developed countries that should maintain their positions or find new ones. Using RPA is necessary for strategic decision making, and also for creating strategic documents such as national strategies of S&T development, smart specialization strategies, and other strategic policy documents. Publication productivity

indicators can also be used for making decisions about financing scientific institutions and projects, as well as for staff recruitment. The scientific publication productivity is one among key indicators used for identification of S&T priorities, a core of new EU framework programm for research and innovation – Horizon 2020.

The scientific output from Mathematics and Physics from the SEE region is comparable with those of others research groups in the world. When analysing Web of Science publications by field of research, Mathematics represents 2.1% of the total worldwide scientific production while Physics accounts for 8.8%, giving a total of 10.9% for Physics and Mathematics combined – over 1,547,187 publications in the period 2005-2010. In South East Europe (Albania, Croatia, FYR of Macedonia, Montenegro, Serbia, Bulgaria, Greece, Hungary, Romania, Slovenia and Turkey), Mathematics is 3.5% of the total scientific production, while Physics is 9.6% - bringing the total for Physics and Mathematics to 13.1%. This is 2.2% better than the worldwide average, with 87,240 publications published by the authors from the SEE compared to 668,384 publications in the whole world in the period 2005-2010. 4.5% of global scientific production in the fields of Mathematics and Physics comes from these 11 countries.

The scientific output from Mathematics and Physics from the SEE region represents majority of the overall scientific output in every particular country in this region, varies from app. one out of ten (in Albania, Croatia, FYR of Macedonia, Greece and Turkey) to one out of 4 scientific publications (in Montenegro, Serbia, Slovenia, Hungary, Bulgaria and Romania). When analysing Web of Science publications by field of research, Mathematics represents the following share of the overall scientific output in SEE countries in the period 2005-2010: 1.2% in Albania, 3.2% in Croatia, 2.4% in FYR of Macedonia, 4.2% in Montenegro, 5.4% in Serbia, 3.3% in Bulgaria, 2.5% in Greece, 4.0% in Hungary, 6.6% in Romania, 4.4% in Slovenia and 2.4% in Turkey. Physics represents the following share of the overall scientific output in SEE countries in the period 2005-2010: 9.9% in Albania, 7.7% in Croatia, 6.6% in FYR of Macedonia, 14.1% in Montenegro, 11.0% in Serbia, 21.2% in Bulgaria, 8.7% in Greece, 11.5% in Hungary, 14.9% in Romania, 11.3% in Slovenia and 6.2% in Turkey. The total for Physics and Mathematics represent the following share of the overall scientific output in SEE countries in the period 2005-2010: 11.2% in Albania, 10.9% in Croatia, 9.0% in FYR of Macedonia, 18.3% in Montenegro, 16.4% in Serbia, 24.5% in Bulgaria, 11.1% in Greece, 15.5% in Hungary, 21.5% in Romania, 15.6% in Slovenia and 8.6% in Turkey.

ACKNOWLEDGMENT

The research presented in this paper was supported by the Ministry of Education and Science of the Republic of Serbia, under the project: "Research and Development of the Platform for Science Based Management of the Scientific and Technological Development of the Republic of Serbia", 2011-2014, reg. no. III 47005.

REFERENCES

[1] Balassa, B., „Trade Liberalisation and "Revealed" Comparative Advantage". The Manchester School, 33: 99–123. (1965). doi: 10.1111/j.1467-9957.1965.tb00050.x

[2] Peter, V., & Bruno, N. (Technopolis Group), International Science & Technology Specialisation: Where does Europe stand?, Luxembourg: Publications Office of the European Union (2010) , doi: 10.2777/83069

[3] Kutlaca, Dj., *Evaluation of the Achieved Technological Level of a Firms and Sectors*, Foundation Andrejević, Belgrade, 2001.

[4] Scopus content overview
http://www.info.sciverse.com/scopus/scopus-in-detail/facts (2012). Accessed 27 May 2012.

[5] Bergman, E. M. L., „Finding citations to social work literature: The relative benefits of using Web of Science, Scopus, or Google Scholar“, *The Journal of Academic Librarianship*, 38 (6) (2012) 370-379.

[6] ISI Web of Science, www.isiknowledge.com (2012) Accessed 24 May 2012.

[7] Bornmann, L., Waltman, L., „The detection of “hot regions” in the geography of science—A visualization approach by using density maps“, *Journal of Informetrics*, 5 (2011) 547 – 553.