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EDITORIAL

Progress in Estonian science

In the period from 2000 to 2014 Estonia experienced many important political and economic changes. For example, Estonia joined both the European Union and NATO in 2004 and the euro area in 2011. In 2000–2008, Estonia's economic growth was on average 7% per year, which placed Estonia among one of the fastest growing economies in Europe. In the autumn of 2008 the country was struck by an economic crisis resulting in 14.1% overall decrease in the GDP growth rate in the next year. Economic growth turned again positive at the beginning of 2010 and the annual GDP grew by 2.6% compared to the previous year. In spite of the modest economic growth during the last years, the budget for the basic research in Estonia has remained on the pre-crisis level. If we take into account inflation then there has been 10–20% less money for basic research than in 2008. In addition, Estonia is deviant from other European countries in respect of funding. National project-based research funding to higher education makes up about 20% on average and rarely goes beyond 50% in any of the OECD countries. In Estonia, however, more than 80% of research funding is project-based coming from the Estonian Ministry of Education and Research (Raudla et al., 2015). How has all this affected the growth of Estonian science?

In a recent paper I proposed the *High Quality of Science Index* (*HQSI*) to measure scientific performance (Allik, 2013). This index combines two indicators – citations per paper and the percentage of highly cited papers – into a composite measure. Table 1 presents the top 20 countries or territories ranked according to the *HQSI*.

Estonian science occupies the 16th position in the *HQSI* ranking and the 27th position in the impact (citations per paper) ranking. Every paper authored by at least one Estonian scientists was cited 12.17 times, which is

Table 1. The top 20 countries/territories ranked according the *High Quality of Science Index*

Rank	Country	Papers	Citations	Citations per paper	Increase 2007–2014, %	Percentage of highly cited papers	*High Quality Science Index*
1	ICELAND	7 625	148 551	19.48	50.2	3.08	2.90
2	SWITZERLAND	236 443	4 575 219	19.35	30.3	2.52	2.40
3	DENMARK	130 038	2 304 081	17.72	31.4	2.30	1.99
4	NETHERLANDS	328 008	5 920 452	18.05	34.8	2.23	1.97
5	USA	3 652 510	63 537 290	17.40	22.8	1.84	1.55
6	SWEDEN	219 516	3 627 388	16.52	30.0	1.91	1.50
7	BELGIUM	180 153	2 911 238	16.16	41.5	1.94	1.48
8	PERU	6 416	83 066	12.95	61.0	2.34	1.39
9	AUSTRIA	122 686	1 859 794	15.16	40.8	1.82	1.24
10	SINGAPORE	94 832	1 281 462	13.51	110.5	2.05	1.22
11	IRELAND	65 000	932 156	14.34	44.3	1.82	1.13
12	CANADA	575 899	8 754 572	15.20	31.3	1.67	1.12
13	NORWAY	99 241	1 438 442	14.49	35.0	1.73	1.07
14	FINLAND	108 892	1 645 728	15.11	25.7	1.63	1.07
15	GERMANY	950 932	14 573 151	15.33	37.0	1.60	1.07
16	**ESTONIA**	13 297	161 886	12.17	54.7	1.94	0.95
17	AUSTRALIA	425 004	5 821 629	13.70	34.3	1.69	0.93
18	FRANCE	673 460	9 732 498	14.45	35.7	1.49	0.85
19	GEORGIA	4 593	42 819	9.32	105.3	2.24	0.83
20	KENYA	10 981	138 480	12.61	47.3	1.74	0.83

Supplementary material is available at http://www.akadeemia.ee/_repository/file/PUBLIKATSIOONID/2015/Allik-1.pdf

larger than the average (11.59). For comparison, Latvian papers were cited on average 8.32 and Lithuanian papers 6.37 times. In the *HQSI* ranking, Estonia holds the position very similar to Germany, Australia, and France. Latvia occupies the 41st position and Lithuania the 65th position in the *HQSI* world ranking.

One of the important indicators is the growth rate of citations per paper. Figure 1 demonstrates that Estonian papers were cited 17.5% less than an average paper in the world over the period 1996–2006. What have been the developments in Estonian science during the 21 century? *Essential Science Indicators* (*ESI*; Thomson Reuters) was updated on 5 March 2015 to cover an 11-year period from 1 January 2004 to 31 December 2014. According to these data for the period 2004–2014 an Estonian paper was cited 5% more than the world average.

Considering that Estonia's real GDP per capita was 13 100 euros in 2014 (http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tsdec100), which is still slightly less than in 2007, while the impact of Estonian scientific papers published in the elite journals indexed by *ESI* had increased 54.7%, the rapid growth of the impact of papers written by Estonian scientists is perplexing. Obviously, there are many factors and their combinations behind the success of Estonian basic science. Looking at the recent success of Estonian science documented by the bibliometric indicators it does not seem that the extremely high percentage of project-based funding has caused any damage to Estonian science. An inevitable consequence of project-based funding is a relatively strong competition for limited funds. A severe competition makes fairness of the decision-making process almost compulsory. Ever since Estonia regained its independence in 1991, most research funding applications have had to be written in English, which allowed for using foreign experts who are more impartial than local experts. In addition, writing all applications in English was an invaluable practice for writing scientifically sound articles to say nothing about internationally competitive and successful grant applications themselves. Considering how small Estonia is, using independent reviewers and evaluators from abroad proved to be the only way for avoiding potential conflicts of interests or simply academic nepotism. Another example of a good governance was the fact that scientific assessment and decision-making were trusted to panels consisting of top-level researchers who were mandated to make sovereign decisions that have been rarely reversed by non-scientific authorities. It seems likely that the relative success of Estonian basic science, documented above, is due to the fact, partly at least, that scientific assessment and decision-making have preserved their autonomy. Panels consisted of the best active scientists decided what questions were important to study and proposals were selected based on their scientific merits, not what science bureaucrats typically think about importance for particular institutions and Estonian economy and society in general.

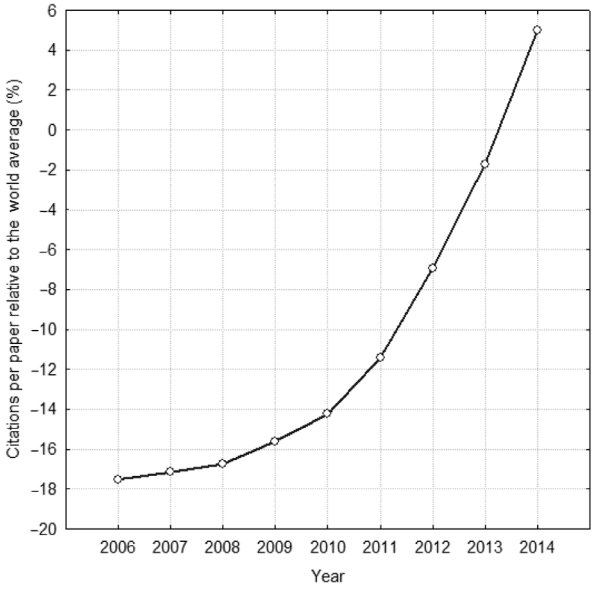

Fig. 1. Impact of Estonian papers relative to the *ESI*'s average.

It is perhaps only a slight exaggeration to say that Lennart Meri (1929–2006), Member of the Estonian Academy of Sciences, Foreign Minister, and President of Estonia, helped to put Estonia back on the map of Europe. He is also remembered by his appeal to invent Estonia's own 'Nokia'. Since then, it has become a national sport to advance the best candidates for our own 'Nokia'. In fact, there are several very good contenders, including, of course, Skype. However, my own preference inclines towards the extraordinary success of Estonian science, which comes perhaps closest to the heart of this appeal.

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