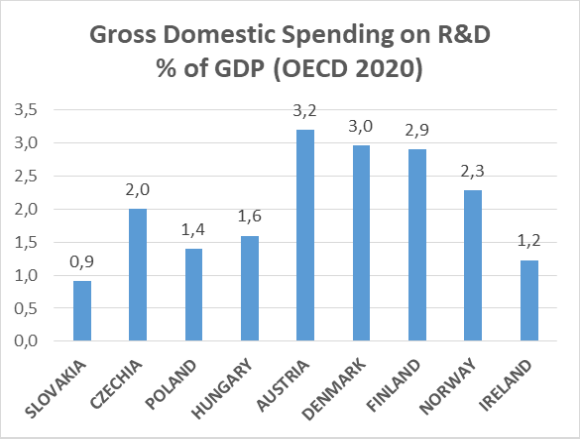
Analysis of Funding and Scientific Output of SAV (Updated Version 2022)

I. Research and development (R&D) in Slovakia and in the selected countries

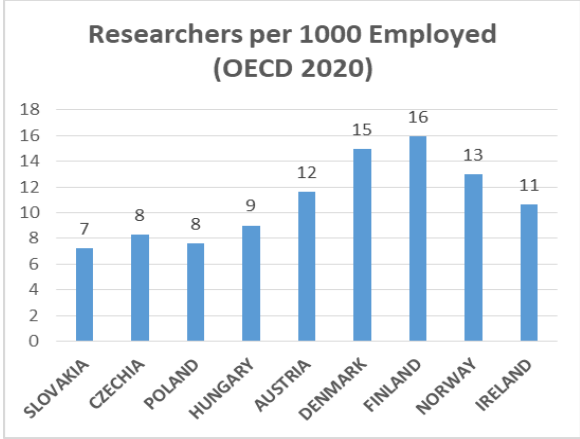
We compared the state of science and research between Slovakia and the so-called V4+ countries, which are close geographically, as well as between Slovakia and countries of similar populations, namely the Scandinavian countries and Ireland.

In studies making similar comparisons, one common theme has been the chronically low level of R&D funding in Slovakia. In 2020, spending on R&D amounted to 0.91 % of GDP, whereas the average in the EU is 2.2 % of GDP. All other V4+ countries are ahead of us in this regard, and the high level of support for R&D in the Scandinavian countries has been well-documented for some time (Graph 1).

Interestingly, the proportion of researchers within the population is lower in the V4 countries than in the other countries examined, which may indicate that young people in particular have less interest in science careers, or that these countries suffer greater brain drain (Graph 2).

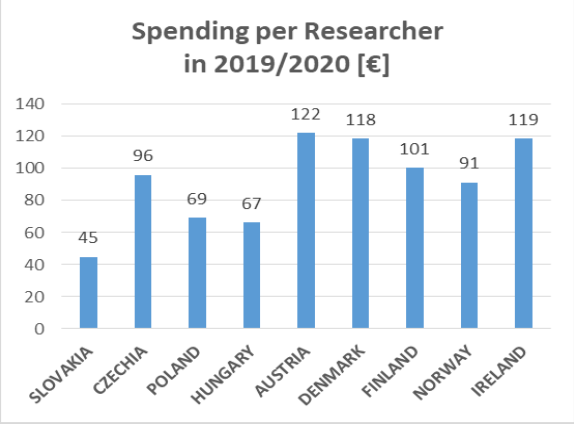


Graph 1: Spending on R&D (% of GDP) in 2020

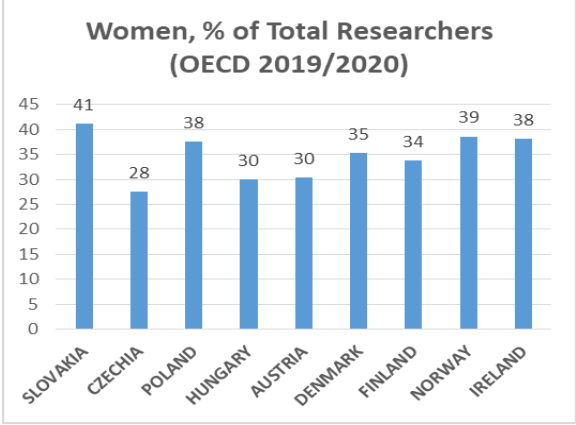


Graph 2: Researchers per 1000 employed in 2020

If funding for R&D is recalculated as the amount spent per scientist (in full-time equivalent; FTE), the resulting trend is similar to that in the previous graphs. Czechia shows the greatest result of all V4 countries, while Austria and the Scandinavian countries spend two to three times more per researcher than Slovakia (Graph 3).

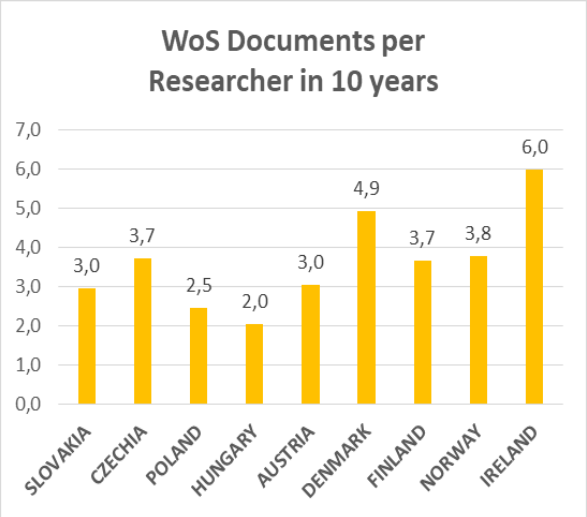


Graph 3: Spending per researcher

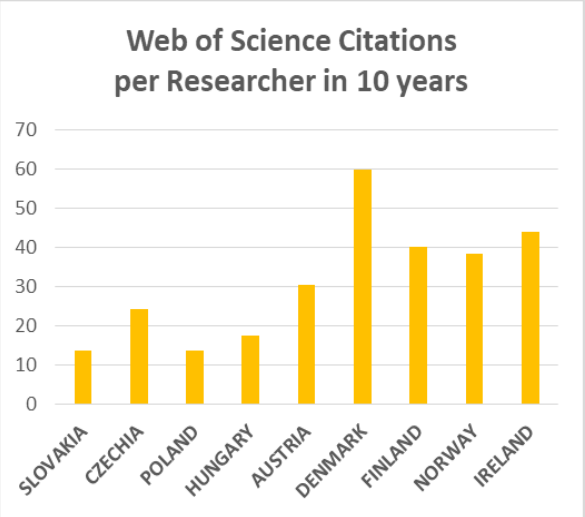


Graph 4: Percentage of women in research

In terms of the number of Web of Science publications per researcher over 10 years, Slovakia falls only slightly behind the other countries except for Ireland and Denmark (Graph 5). However, Slovakia falls far behind in terms of the number of citations (Graph 6).



Graph 5: Web of Science documents per researcher in 2012-2021

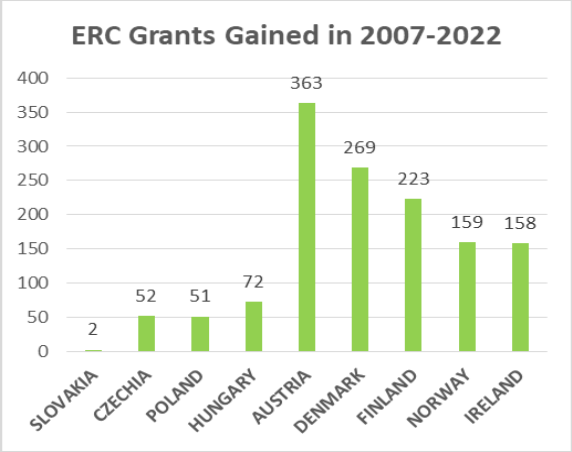


Graph 6: Web of Science citations per researcher over 10 years

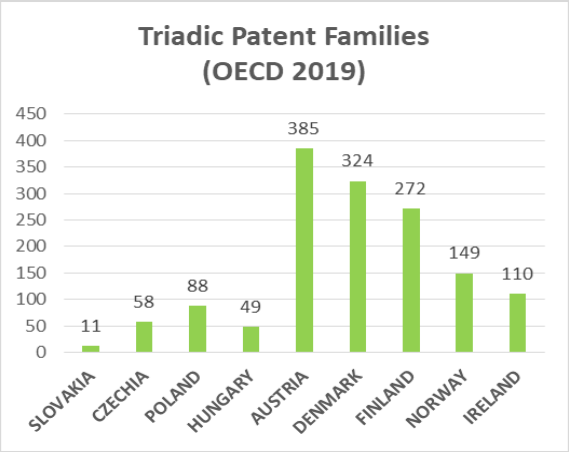
As **indicators of top-level science**, we evaluated the number of ERC grants gained in 2007-2022, placement within the Nature Index ranking in 2020, the number of highly cited Web od Science documents, and score in Triadic Patent Families in 2019.

Regarding ERC grants, Austria and the Scandinavian countries were, once again, top of the ladder, while Hungary led the V4 countries. Slovakia has gained only two ERC grants (Graph 7). The similar results are mirrored in the OECD indicator of Triadic Patent Families[1], where Austria dominates with 385 registered patents, followed by Denmark and Finland. Slovakia scored with only 11 registered patents in 2019 (Graph 8).

[1] Definition of Triadic patent families: A triadic patent family is defined as a set of patents registered in various countries (i.e. patent offices) to protect the same invention. Triadic patent families are a set of patents filed at three of these major patent offices: the European Patent Office (EPO), the Japan Patent Office (JPO) and the United States Patent and Trademark Office (USPTO). Triadic patent family counts are attributed to the country of residence of the inventor and to the date when the patent was first registered. This indicator is measured as a number. OECD (2022), Triadic patent families (indicator). doi: 10.1787/6a8d10f4-en (Accessed on 15 June 2022).

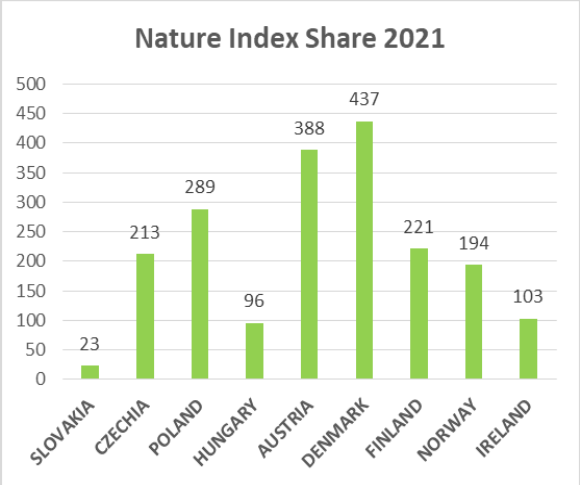


Graph 7: ERC grants gained

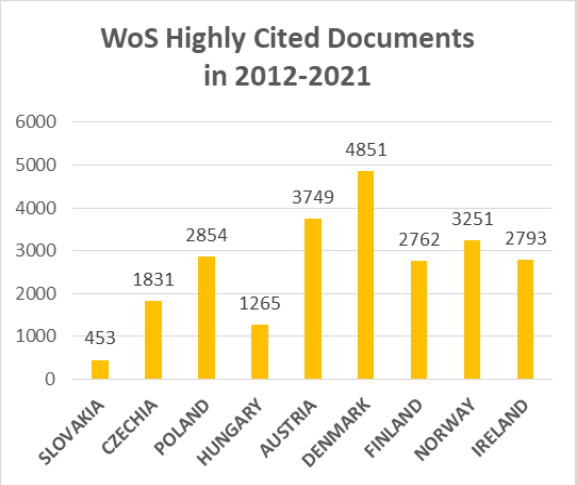


Graph 8: Triadic patent families (OECD)

Another possible indicator of top-level research is the number of publications in Nature Index journals[2]. The fractional count (FC) indicator takes into account the percentage of authors from a certain country or organization, as well as the total number of countries (organizations) represented among the authors of the article. Using this indicator, Slovakia can still be found on the bottom rung; among the V4 countries, Poland won the best placement (Graph 9). The situation is similar if we look at the Web of Science Highly Cited Documents in 2012-2021,[3] where Slovakia has 453 publications, while Czechia has 1831 and Denmark 4851 (Graph 10).



Graph 9: Publications in Nature Index journals



Graph 10: Web of Science highly cited documents

Taken together, it is clear that Slovakia is falling behind in all indicators, especially those that identify excellent science. This situation correlates with low funding for R&D in the country. On the other hand, Slovakia is scoring 41% in share of women in research, which is the best number out of analyzed countries (Graph 4).

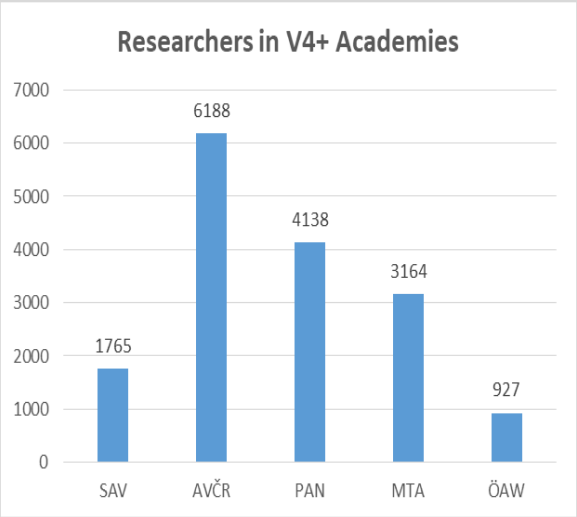
[2] Group of 82 high-quality journals selected by the panel of independent excellent scientists
[3] Sum of the publications ranked amongst top 1 % of publications within last 10 years.

II. SAV compared with the Academies of Sciences in the surrounding countries

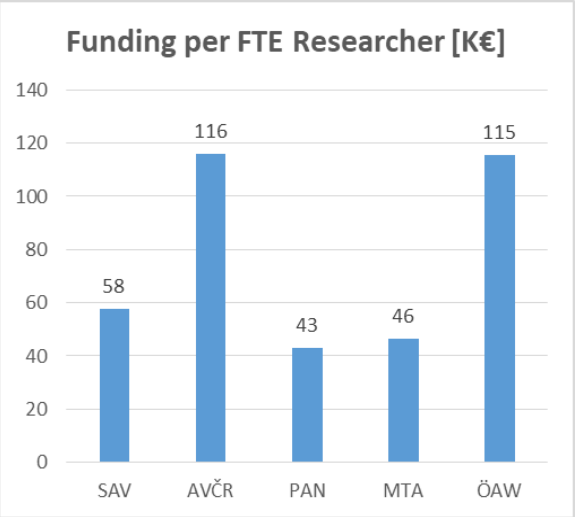
We compared SAV with the Academies of Sciences in the V4+ countries that is the Czech Academy of Sciences (AVČR), the Hungarian Academy of Sciences (MTA), the Polish Academy of Sciences (PAN), and the Austrian Academy of Sciences (ÖAW).

Number of researchers in the V4+ academies varies from 927 ÖAW, 1765 in SAV, through 3164 in MTA, to 4138 in PAN and 6188 researchers in AVČR (Graph 11). The annual budget of SAV is around 102 million EUR, while that of MTA is around 146 million EUR, budget of PAN is 178 million EUR, that of ÖAW is over 107 million EUR and the AVČR budget is about 717 million EUR.[4] As a result, SAV falls far behind AVČR and ÖAW, but scores little bit better than PAN and MTA in terms of available funding per researcher. Specifically, SAV has an annual budget of 58,000 EUR per FTE researcher, while AVČR has 116,000 EUR and ÖAW has 115,000 EUR (Graph 12).

This reflects on the employees' salaries: the average monthly wage of SAV employees is 1566 EUR (1782 EUR for researchers), while that of CAS employees is 1895 EUR (2371 EUR for researchers).[5]



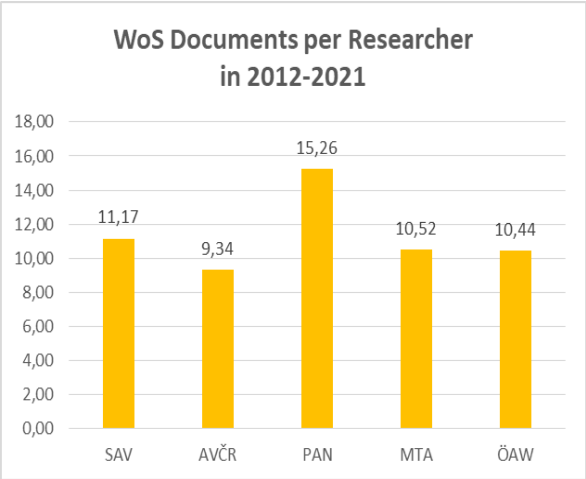
Graph 11: FTE researchers in V4+ academies



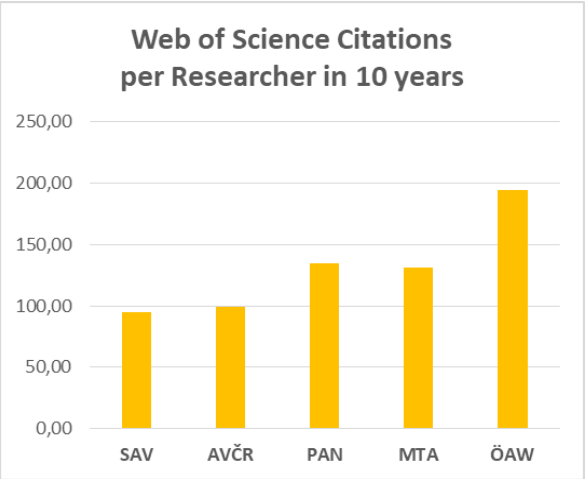
Graph 12: Funding per researcher in V4+ academies

Given the total number of researchers (FTE), SAV produces the similar number of documents in Web of Science per researcher as AVČR, MTA and ÖAW, and they all fall behind PAN (Graph 13). In terms of Web of Science citations, SAV is very similar to AVČR, PAN and MTA but they all fall behind ÖAW (Graph 14).

[4] ÖAW data on number of FTEs and annual budget are from 2017; SAV, AVČR, PAN and Eötvös Research Network data from 2021.
[5] Information unavailable for the other academies (Annual Reports 2021).

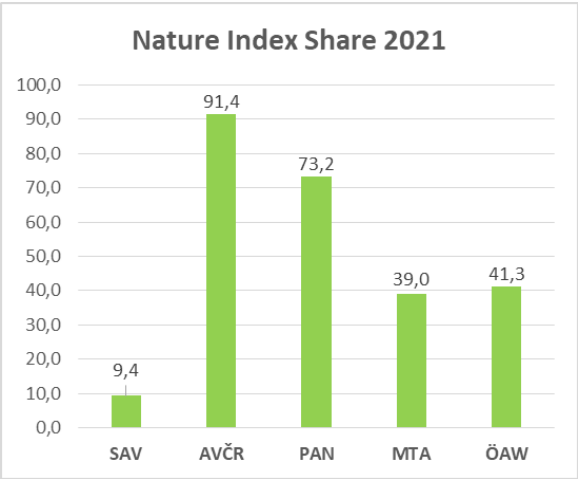


Graph 13. WoS documents per researcher

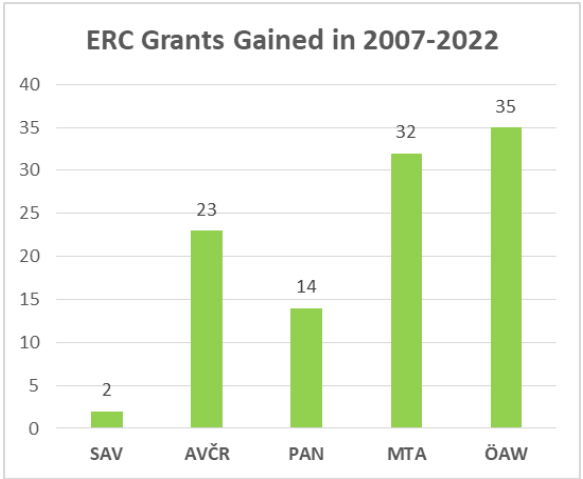


Graph 14. WoS citations per researcher

As per the available data, SAV is able to produce one Web of Science publication for 51,730 EUR, which is more than a price of one publication for PAN (28,144 EUR) and MTA (43,964 EUR), but less than the price of a publication for AVČR (124,113 EUR) or ÖAW (121,517 EUR). However, SAV produced very few publications in the top Nature Index journals, falling behind the other academies (Graph 15). The number of ERC grants gained is also several times lower (Graph 16).



Graph 15: Publications in the Nature Index (2021)



Graph 16: ERC grants gained

Table 1 shows the placement of the Academies of Sciences in the Global and Europe Nature Index ranking in February 2022. Table 2 shows the change in adjusted share of Nature Index publications. Although SAV is ranked very low, there was 18% increase compared to 2020.

	Nature Index – Global 2022	Nature Index – Europe 2022
SAV	1029	347
AVČR	172	42
PAN	215	61
MTA	378	122
ÖAW	386	126

Table 1: Position in the Nature index in February 2022

	Nature Index Count 2021	Nature Index Share 2021	Nature Index Change in Adjusted Share 2020-2021
SAV	112	9,36	+ 18 %
AVČR	470	91,36	- 6 %
PAN	389	73,15	- 5 %
MTA	286	38,97	- 25 %
ÖAW	270	41,26	+ 17 %

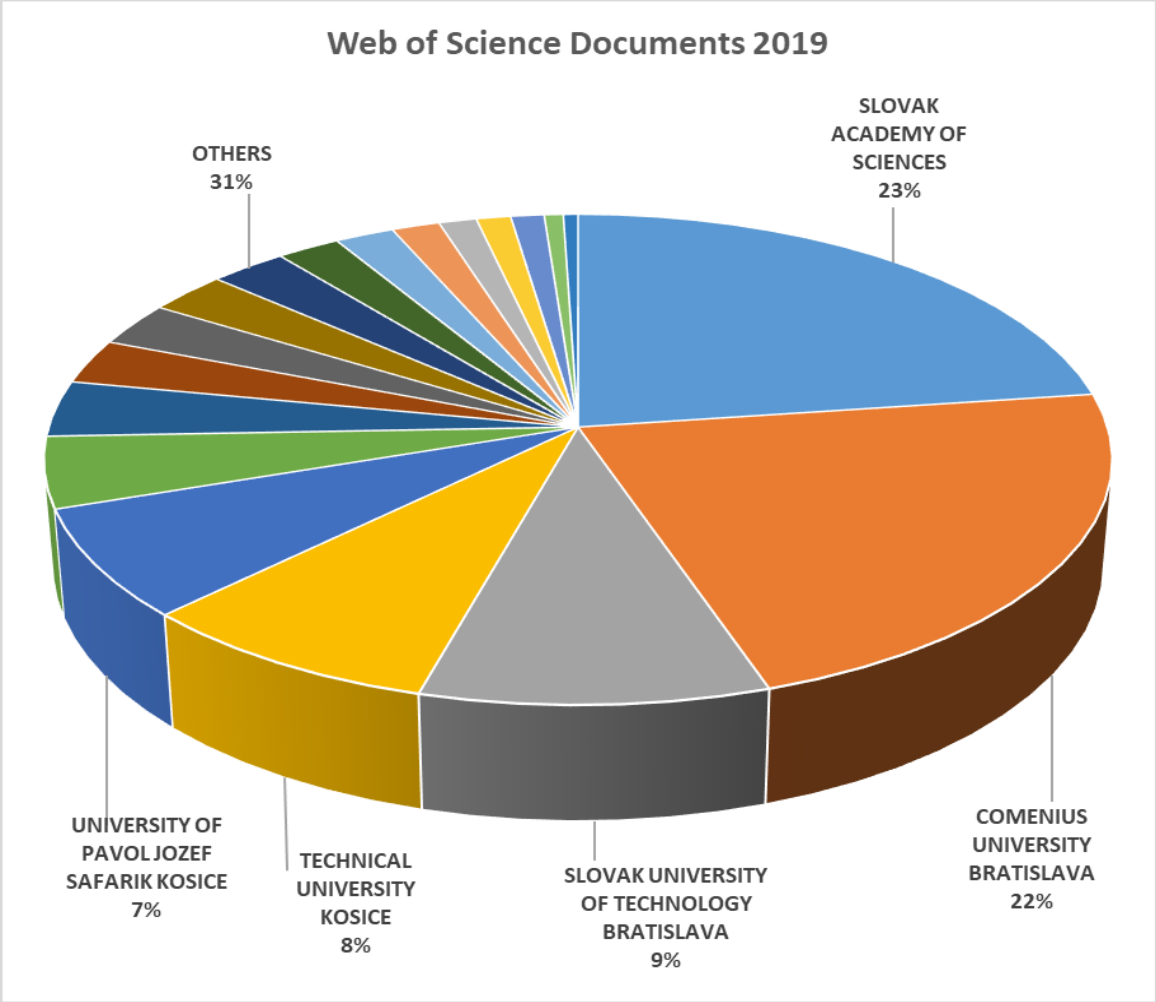
Table 2: Nature Index Change in Adjusted Share 2020-2021

III. SAV in Slovakia

Within Slovakia, SAV was evaluated against the seven leading research universities, which were listed in the Nature Index in 2019: Comenius University in Bratislava (UK), Slovak University of Technology (STU), Technical University in Košice (TUKE), Pavol Jozef Šafárik University (UPJŠ), University of Ss. Cyril and Methodius (UCM), Matej Bel University (UMB) and Trnava University (TTU).

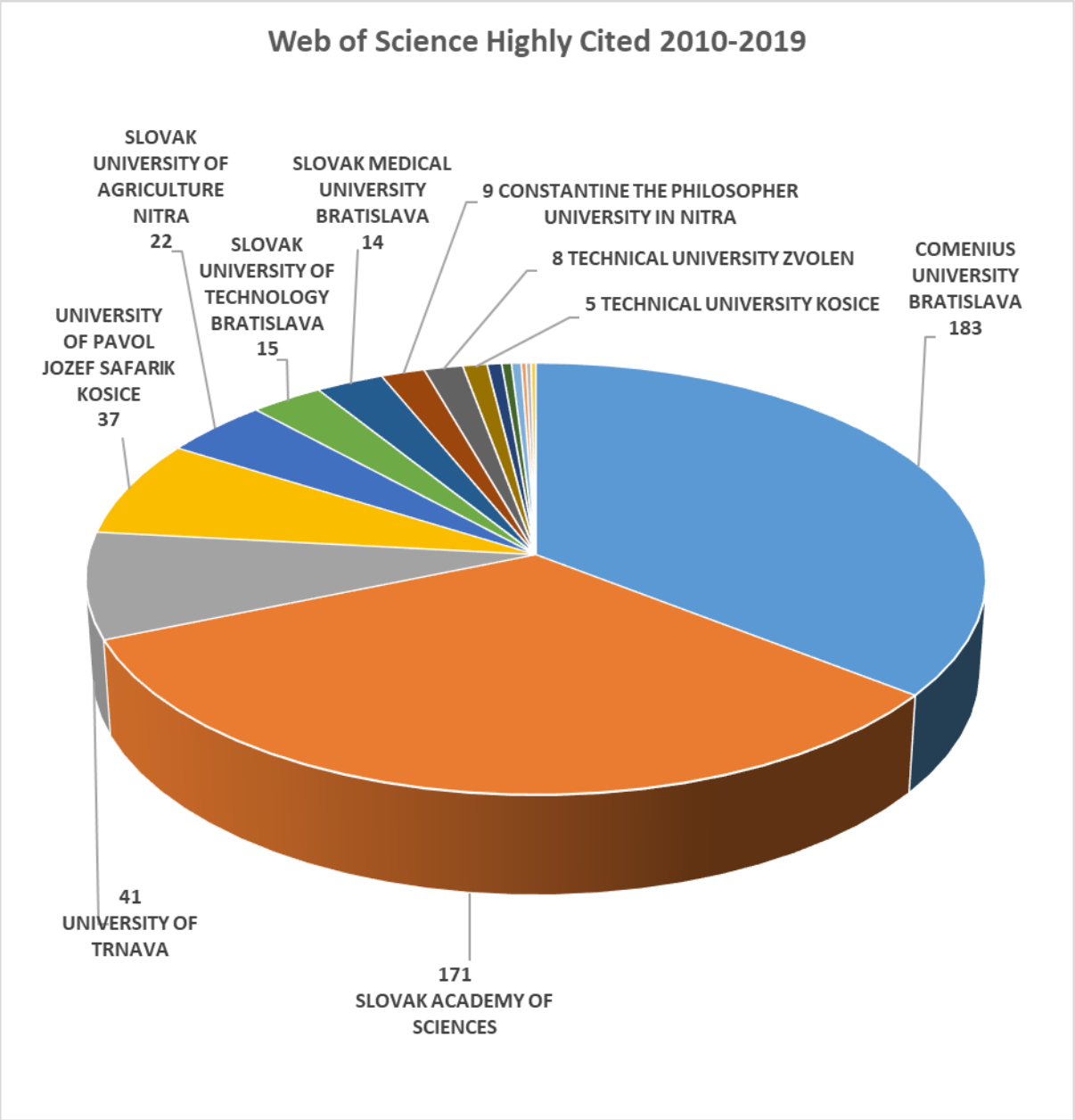
In 2021, SAV employed 1765 researchers, UK 2637, STU 1296, TUKE 779, UPJŠ 871, UCM 313, UMB 455 and TTU 297 (FTE).[6] SAV produced 23% of all Slovak Web of Science documents and scored the first place in 2019. Together with UK, these two institutions produced 45% of all Slovak Web of Science documents. The other major contributors were STU (9%), TUKE (8%) and UPJŠ (7%). All the other Slovak Universities accounted together for 31% of the Slovak Web-of-Science Documents (Graph 17).

[6] www.portalvs.sk, data as for 31st December 2019



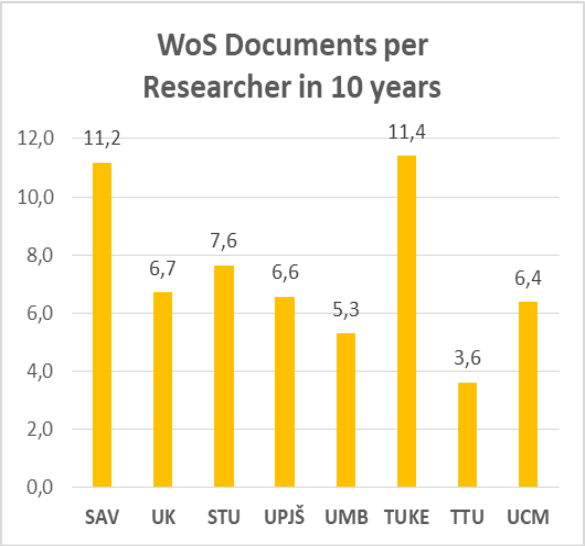
Graph 17: Contribution of Slovak research institution to Web of Science publications

The dominance of two main Slovak research institutions (SAV and UK) in 2019 Web of Science documents is much more visible in the share of highly cited documents in 2010-2019 where these two institutions account for 69% of the share (Graph 18). Interestingly, SAV scores worse (171 documents) than UK (183 documents), which is the best Slovak research institution in this regard. Third place belongs to TTU (8%), followed by UPJŠ (7%), Slovak University of Agriculture (SPU, 4%), STU (3%) and Slovak Medical University (SZU, 3%). All the other universities produced less than 10 highly cited documents in 10 years (6%). What is interesting here is that two universities (SPU and SZU) scored better in this indicator than four universities listed in Nature Index (STU, TUKE, UCM and UMB).

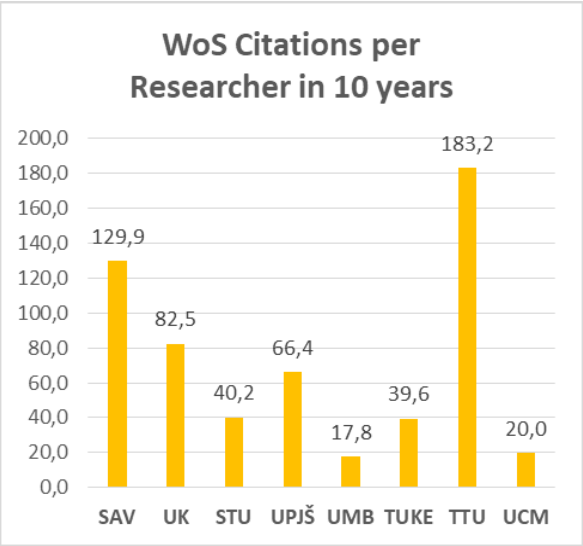


Graph 18: Contribution of Slovak research institution to Web of Science highly cited publications

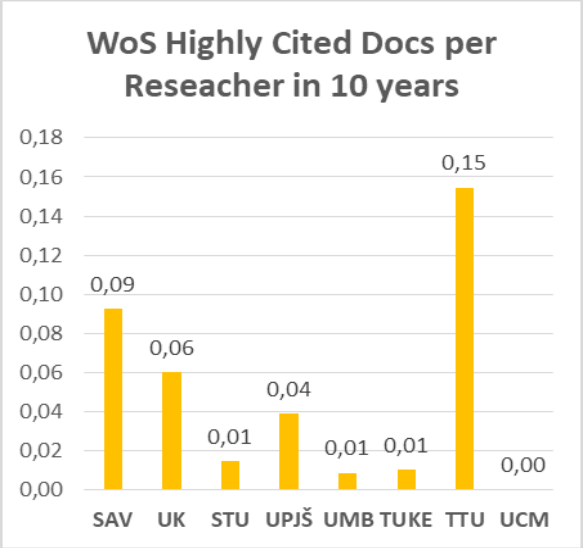
In 2021, after correcting for the number of researchers (FTE), SAV scores the second place slightly behind TUKE in the number of Web of Science publications in 2012-2021 (Graph 19) and similarly the second place behind TTU in the number of Web of Science citations (Graph 20). SAV scores the second place also in the Web of Science highly cited documents per researcher in 2012-2021 where the first place belongs again to TTU (Graph 21). SAV scores the first place in the Nature Index share slightly ahead of UK (Graph 22, Table 3). The highest increased in Nature Index Share in 2020-2021 was scored by TTU (+3277%), followed by STU (+104%) (Table 3). A steady change between these two years was also recorded by UK (+27%), SAV (+18%) and TUKE (+3%).



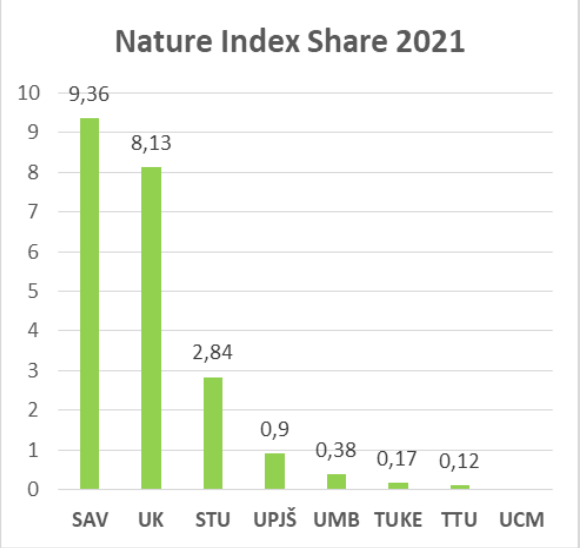
Graph 19: Web of Science publications per researcher in 10 years (2012-2021)



Graph 20: Web of Science citations per researcher in 10 years (2012-2021)



Graph 21: Web of Science top publications



Graph 22: Publications in the Nature index

	Nature Index Global February 2022	Nature Index Europe February 2022	Nature Index Change in Adjusted Share 2020-2021
SAV	1029	347	+18%
UK	976	323	+27%
STU	1603	545	+104%
UPJŠ	2614	872	-37%
UCM	N/A	N/A	N/A
UMB	3600	1226	-17%
TTU	4700	1656	+3277%
TUKE	4330	1512	+3%

Table 3: Position in the Nature Index in February 2022

Summary

SAV remains between leading institutions within the Slovak science community in terms of both quantitative and qualitative parameters, as well as in indicators of top-level science. In 2021, the major contenders for SAV within Slovakia are UK, TUKE and TTU. SAV scores the first place in the Nature Index share slightly ahead of UK and followed by STU. SAV scores the second place slightly behind TUKE in the number of Web of Science publications in 2012-2021 and similarly the second place behind TTU in the numbers of Web of Science citations and highly cited WoS documents per researcher in 2012-2021.

When compared to V4+ academies of sciences, SAV has only around half of the funding per researcher compared to AVČR and ÖAW. SAV, however, is equal player with these two academies in terms of publications per researcher (where it falls behind PAN). In terms of citations, SAV is very similar to AVČR and PAN and they all fall behind MTA and ÖAW. Nevertheless, SAV falls far behind the other academies in terms of indicators of top-level science (ERC grants, Nature Index). In comparison with the Scandinavian countries, the difference is even starker.

Data sources

– Annual reports of the organizations
– Styčná kancelária SR pre výskum a vývoj v Bruseli
– ERC website
– Eurostat
– Nature Index
– OECD: Indicators: Researchers (doi: 10.1787/20ddfb0f-en), Gross domestic spending on R&D (doi: 10.1787/d8b068b4-en), Triadic patent families (doi: 10.1787/6a8d10f4-en) (Accessed on 15 June 2022)
– Web of Science