

CHALLENGES TO THE COMPETITIVENESS OF THE SCIENCE SPHERE IN ARMENIA

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Introduction. Scientific research stimulates technological progress, which directly enhances productivity and fosters economic growth. Empirical studies demonstrate that an increase in scientific output, such as publications, patents, and research and development (R&D) investments, leads to technological innovations, which in turn contribute to GDP growth and improvements in living standards. Currently, science serves not only as a driver of technological advancement but also as a crucial social and humanitarian institution exerting a significant impact across all spheres of public life. A nation's development, its competitiveness, and its global standing are directly contingent upon the state and prospects of its intellectual resources. The foregoing considerations substantiate the importance, urgency, and relevance of studying this topic.

The objective of this article is to examine the current state of the science sector in the Republic of Armenia (RA), identify the fundamental challenges within the sector, and develop specific measures aimed at addressing them. To achieve this objective, the following tasks were formulated:

- to examine the current state of development of the RA science sector,
- to analyze the types of funding for the science sector,
- to study the "brain drain" sub-index in different years and its primary causes,
- to develop measures for the elimination of these causes.

Literature Review. Studies and analyses on science are extensive. A substantial body of literature substantiates the effectiveness of investments in science and technology. For example, Xiangfei Ma et al. (2024) emphasize the importance of scientific and technological activity, noting that the rapid changes currently taking place worldwide are largely driven by advances in science and technology, which in turn are rooted in scientific and technical activities (STA). Within the framework of their study, the authors assess the level of STA across countries worldwide, including Ukraine, and analyze the impact of STA on sustainable economic growth¹.

The importance of research and development (R&D) and innovation for sustainable economic growth is clearly reflected in the EU's *Europe 2020* agenda, where "smart, sustainable, and inclusive growth" was established as the EU's new strategic

¹ Ma, X.; Gryshova, I.; Khaustova, V.; Reshetnyak, O.; Shcherbata, M.; Bobrovnyk, D.; Khaustov, M. Assessment of the Impact of Scientific and Technical Activities on the Economic Growth of World Countries. *Sustainability* 2022, 14, 14350. <https://doi.org/10.3390/su142114350>

objective. It was envisaged that Member States should allocate 3% of GDP to R&D expenditure. The EU maintains that support for R&D should help Member States sustain long-term economic growth while simultaneously reducing unemployment, enhancing competitiveness, and narrowing regional disparities².

Other authors, Mallick L. et al. (2016), sought to identify the relationship between education expenditure and economic growth in 14 Asian countries over the period 1973–2012. Based on their analysis, they conclude that a long-run cointegrating relationship exists between education spending and economic growth in all the countries examined³.

Other authors, Brautzsch, H.U. et al. (2015), concluded that during the economic crisis of 2008–2009 in Germany, support for research and development proved highly effective, generating a significant leverage effect and offsetting the 0.5% decline in GDP in 2009⁴.

The findings of the study by Rehman N.U. et al. indicate a high intensity of university and private sector research and development in European countries, confirming the existence of strong research links between universities and industry. Based on their empirical analysis, they revealed that, to effectively cope with economic crises, government-funded special R&D programs, such as tax incentives, R&D grants, and subsidies, would stimulate technological innovations in the private sector⁵.

In their study, Corea P. et al. employed meta-analysis methods based on 37 studies published between 2004 and 2011. The results showed that the impact of public investment on research and development is predominantly positive and significant, as public funding does not crowd out private investment but instead encourages firms to invest in research and development⁶.

Methodology. The informational basis of the article consists of scientific articles by domestic and foreign authors related to the field, information published on both national and international information platforms, as well as regulatory legal acts

² Communication from the commission Europe 2020 ,A strategy for smart, sustainable and inclusive growth, Brussels, 3.3.2010 COM (2010) 2020 final

³ Mallick L, et al, 2016, Impact of educational expenditure on economic growth in major Asian countries: Evidence from econometric analysis, Theoretical and Applied Economics Volume XXIII (2016), No. 2 (607), Summer, pp. 173–186.

⁴ Brautzsch, H.U.; Gunther, J.; Loose, B.; Ludwig, U.; Nulsch, N. Can R&D subsidies counteract the economic crisis? Macroeconomic effects in Germany. *Res. Policy* 2015, **44**, 623–633.

⁵ Rehman, N. U., Hysa, E., & Mao, X. (2020). Does public R&D complement or crowd-out private R&D in pre and post economic crisis of 2008? *Journal of Applied Economics*, 23(1), 349–371.
<https://doi.org/10.1080/15140326.2020.1762341>

⁶ L.A. Andres, P. Correa, Ch. Borja-Vega, The Impact of Government Support on Firm R&D Investments: A Meta-analysis, The World Bank Entrepreneurship and Innovation Unit South Asia Sustainable Development Department, Water and Sanitation Program July 2013,
https://www.researchgate.net/publication/260896192_The_Impact_of_Government_Support_on_Firm_RD_Investments_A_Meta-analysis

governing the sector. In the course of the analysis, methods of data collection, analysis, and synthesis were applied.

Analysis. Today, countries around the world must increasingly adapt to rapid economic, technological, and social changes occurring in a globalized world in order to ensure sustained economic growth. Many of these transformations are driven by scientific and technological progress, which, in turn, is underpinned by the development and expansion of scientific and technological activities⁷.

As a result of scientific and technological activity, new ideas, products, services, and skills are generated, contributing to improvements in the quality of life of individuals and society as a whole. In this regard, a general upward trend in public investment in science has been observed globally over recent decades. The importance of scientific research in addressing global challenges—ranging from climate change to digitalization and medical innovation—is increasingly emphasized.

The Republic of Armenia, despite its limited economic resources, actively participates in international scientific projects and seeks to develop its domestic scientific infrastructure. Nevertheless, both the scale and the effectiveness of public investment in science remain insufficient to significantly stimulate economic growth. The scholarly literature highlights the diversity of national approaches to science policy. In particular, European models are distinguished by a high degree of strategic planning, substantial public funding, and integration into supranational frameworks, most notably within the European Research Area.

Target 9.5 of the United Nations Sustainable Development Goals (SDGs) is formulated as “Enhancing scientific research and upgrading the technological capabilities of industrial sectors,” and emphasizes the strengthening of research and development (R&D), as well as the upgrading of technological capacities in all countries, particularly developing economies⁸. This target includes measures aimed at encouraging innovation by 2030, increasing the number of researchers, and expanding expenditures on research and development. In this sense, the SDGs highlight the necessity of enhancing the potential of scientific and technological activities (STA) and improving their outcomes.

The ways in which science can support the 2030 Agenda for Sustainable Development have been examined by Schneider et al. (2019)⁹. By analyzing the impact of research and development on sustainable economic growth, the authors emphasize

⁷ Ma, X.; Gryshova, I.; Khaustova, V.; Reshetnyak, O.; Shcherbata, M.; Bobrovnyk, D.; Khaustov, M. Assessment of the Impact of Scientific and Technical Activities on the Economic Growth of World Countries. *Sustainability* 2022, 14, 14350, <https://doi.org/10.3390/su142114350>

⁸Sustainable Development Goal 9. Build Resilient Infrastructure, Promote Sustainable Industrialization and Foster Innovation/Sustainable Development Goals. SDG Tracker. Available online: <https://sdg-tracker.org/infrastructure-industrialization>

⁹ Schneider F., et al, 2019, How can science support the 2030 Agenda for Sustainable Development? Four tasks to tackle the normative dimension of sustainability, *Sustainability Science* (2019) 14:1593–1604 <https://doi.org/10.1007/s11625-019-00675-y>

the need to intensify scientific activity under conditions of global challenges and to create favorable conditions for economic growth across all countries¹⁰. In this context, technologies and innovations that promote “green growth” are of particular importance. According to OECD data, green growth provides a practical and flexible approach for achieving tangible progress across both economic and environmental dimensions, while fully accounting for the social consequences of “greening” economic growth.

Scientific, technical, and technological research in the field of green growth contributes to the conservation of natural resources and enables economies to realize their full long-term potential on a sustainable basis. This includes the provision of essential ecosystem services such as clean air and water, as well as the preservation of biodiversity, which are critical for food production and human health¹¹.

The analysis of the scientific sector cannot be comprehensive without an examination of funding levels. In the Republic of Armenia, the current state of science financing is characterized by relatively low indicators. According to statistical data, expenditure on research and development in Armenia as a share of GDP has fluctuated between 0.20% and 0.26% in recent years (Table 1). When compared with international practice, this level is considered quite low and, in our view, represents one of the factors contributing to the “brain drain.”

Table 1

Share of science funding in GDP, as well as by sources of provision, 2023¹²

Country	State	Private sector	Share in GDP
Armenia	52.7	16.8	0.23
Georgia	38.4	27.3	0.33
Germany	13.9	69.8	3.1
OECD Average	10.4	67.9	2.7
EU Average	11.2	66.4	2.2
Romania	35.2	33.1	0.51
Israel	5.7	59.3	6.3
Czech Republic	17.8	59.7	1.98

The data presented in the table indicate that Armenia is broadly comparable to Georgia in this respect. As observed, funding for science in Armenia is predominantly

¹⁰ Sustainable Development Goal 9. Build Resilient Infrastructure, Promote Sustainable Industrialization and Foster Innovation/Sustainable Development Goals. SDG Tracker. Available online: <https://sdg-tracker.org/infrastructure-industrialization>

¹¹ OECD. What Is Green Growth and How Can It Help Deliver Sustainable Development? Green Growth and Sustainable Development. Available online: <https://www.oecd.org/greengrowth/whatisgreengrowthandhowcanithelpdeliverustainabledevelopment.ht>

¹² OECD (2024). *Main Science and Technology Indicators (MSTI) Database*; UNESCO Institute for Statistics (UIS) Data Centre – *Gross Domestic Expenditure on R&D (GERD) by sector of performance*. https://stats.oecd.org/Index.aspx?DataSetCode=MSTI_PUB , <https://uis.unesco.org>

provided through the state budget, while investment from the private sector remains at a very low level. This stands in contrast to countries with well-developed scientific systems, where private-sector funding plays a substantially larger role in financing research and development.

Since “brain drain” is one of the obstacles to the sustainable development of the science sector in Armenia, within the scope of this article, it was deemed necessary to also examine the Fragile States Index (FSI), which is calculated in international practice¹³. It is usually calculated using 12 sub-indices, which include the “brain drain” sub-index. The value of each sub-index ranges from 0 to 10; notably, the closer the value is to 10, the more vulnerable the country is considered. A high value indicates that the country is more unstable and vulnerable, whereas a lower value reflects greater stability. The overall score of the index is interpreted as follows: 0-30; very stable country, 30-60; stable, 60-90; vulnerable, and 90-120; critically vulnerable. Within the scope of this article, Armenia’s position in this index over recent years has been analyzed (Table 2).

Table 2

The Brain Drain index in Armenia, 2014-2024¹⁴

	Rank	Total	Refugees and IDPs	External intervention	Human Flight / Brain drain	Public service	Human rights
2014	104	71.3	6.7	6.5	5.7	4.4	6.8
2015	108	69.7	7.0	6.8	6.0	4.1	6.5
2016	109	69.6	6.7	6.9	5.9	3.8	7.0
2017	102	71.0	7.0	6.7	6.2	3.6	7.0
2018	102	69.5	6.7	6.4	6.1	3.4	6.9
2019	105	66.7	6.4	6.3	6.4	3.3	6.6
2020	108	64.2	6.1	6.0	6.5	3.3	6.3
2021	91	69.8	6.6	7.0	6.8	3.9	6.0
2022	97	67	6.5	6.9	6.7	3.6	6.7
2023	93	67.5	6.8	7.0	7.2	3.4	5.8
2024	89	68.1	7.3	7.5	6.9	3.9	5.5

It should also be noted that, among the 12 sub-indices of this index, those of significant importance have been highlighted in the table. Thus, in 2024, Armenia was considered a non-risk country but with moderately high vulnerability, as it ranked 89th

¹³ Fund for Peace. (n.d.). *Fragile States Index indicators*. Fragile States Index. <https://fragilestatesindex.org/indicators/>

¹⁴ Fund for Peace. (n.d.). *Fragile States Index indicators*. Fragile States Index. <https://fragilestatesindex.org/indicators/>

out of 179 countries in this index, with an overall score of 68.1, improving its position by 4 places compared to 2023 (93rd place)¹⁵.

Among the most concerning areas are external impact (7.5) and displacements (7.3), which are consequences of conflicts, while the “emigration and loss of specialists” sub-index stood at 6.9, which is also worrisome. Notably, the most favorable value for Armenia was recorded for the public services sub-index, which amounted to 3.9 in 2024. Data from the last ten years indicate that the “brain drain” sub-index reached its highest value in 2023, associated with the unstable political situation in Armenia. Analyzing this index, it can be concluded that in 2024 Armenia was in a non-war state; however, security and external risks were considered vulnerable, which explains its inclusion in the group of “sensitive states”.

Conclusions. In conclusion, based on the conducted analysis, the following recommendations can be formulated. In particular, it is necessary to prevent brain drain, which can be achieved by providing scientific personnel with competitive salaries, social guarantees, and opportunities for professional development. A major constraint to the development of science in the Republic of Armenia is the low level of funding from the private or business sector, despite the fact that such financing plays a crucial role in building an advanced scientific system, as evidenced by indicators observed in various countries worldwide. It should also be noted that in the Republic of Armenia the linkages among the state, science, and the economy remain weak, which constitutes a significant barrier to the commercialization of research outcomes.

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¹⁵ Fund for Peace. (n.d.). *Fragile States Index indicators*. Fragile States Index.
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ԳԻՏՈՒԹՅԱՆ ՈԼՈՐՏԻ ՄՐՑՈՒՆԱԿՈՒԹՅԱՆ ՄԱՐՏԱՀՐԱՎԵՐՆԵՐԸ ՀԱՅԱՍՏԱՆՈՒՄ

ԵՎԳԵՆՅԱ ՀԱԿՈԲՅԱՆ

Համառոտագիր

Գիտական հետազոտությունները խթանում են տնտեսության տեխնոլոգիական առաջընթացը, որն անմիջականորեն մեծացնում է արտադրողականությունը և խթանում տնտեսական աճը: Էմպիրիկ հետազոտությունները ցույց են տալիս, որ գիտական արտադրանքի աճը, ինչպիսիք են հրապարակումները, արտոնագրերը և հետազոտությունների ու զարգացման ներդրումները, հանգեցնում է տեխնոլոգիական

նորարարությունների, ինչն էլ իր հերթին նպաստում է ՀՆԱ-ի աճին և կենսամակարդակի բարելավմանը: Այդ ամենին զուգահեռ գիտությունը ոչ միայն հանդիսանում է տեխնոլոգիական առաջընթացի շարժիչ, այլ սոցիալական, հումանիտար կարևորագույն ինստիտուտ, որն էական ազդեցություն է ունենում հասարակական կյանքի բոլոր ոլորտներում: Երկրի զարգացումը, նրա մրցունակությունն ու համաշխարհային դիրքը անմիջականորեն կախված են մտավոր ռեսուրսների վիճակից և հեռանկարից: Վերոնշյալն էլ հիմնավորում է տվյալ թեմայի ուսումնասիրման արդիականությունը: Սույն հոդվածի *նպատակն* է ուսումնասիրել ՀՀ գիտության ոլորտի մրցունակության մարտահրավերները: Տվյալ նպատակին հասնելու համար աշխատանքում դրվել են *խնդիրները*, մասնավորապես. ուսումնասիրել ՀՀ գիտության ոլորտի զարգացման ներկայիս վիճակը, վերլուծել գիտության ոլորտի ֆինանսավորման տեսակները, ուսումնասիրել «ուղեղների արտահոսքի» ենթաինդեքսը տարբեր տարիներին, և վեր հանել այդ արտահոսքի հիմնական պատճառները, մշակել դրանց վերացմանն ուղղված միջոցառումներ: Ստացված արդյուքների հիման վրա կարևորվել է հետևյալը. կանխել ուղեղների արտահոսքը, որը հնարավոր է գիտական կադրերին մրցունակ աշխատավարձերի, սոցիալական երաշխիքների և զարգացման հնարավորությունների տրամադրմամբ: ՀՀ գիտության զարգացման համար, որպես էական խոչընդոտ է հանդիսանում մասնավոր կամ բիզնես հատվածի ֆինանսավորման նվազ ծավալները, որը, զարգացած գիտական համակարգ ունենալու գործում մեծ դերակատարում ունի, ինչի մասին էլ վկայում են աշխարհի տարբեր երկրներում գրանցած ցուցանիշները: ՀՀ-ում դեռևս թույլ է պետություն-գիտություն-տնտեսություն, կապը, որն էլ էական խոչընդոտ է հանդիսանում գիտական արդյունքների առևտրայնացման համար:

Բանալի բառեր. Գիտություն, ՀՆԱ, գիտական հետազոտություններ, մշակումների վրա իրականացված ծախսեր, ֆինանսավորում, «ուղեղների արտահոսք»

ВЫЗОВЫ КОНКУРЕНТОСПОСОБНОСТИ НАУЧНОЙ СФЕРЫ В АРМЕНИИ

АКОПЯН ЕВГЕНИЯ

Аннотация

Научные исследования стимулируют технологический прогресс в экономике, что напрямую повышает производительность и способствует экономическому росту. Эмпирические исследования показывают, что увеличение научной продуктивности, такой как публикации, патенты и инвестиции в исследования и разработки, приводит к технологическим инновациям, которые, в свою очередь, способствуют росту ВВП и повышению уровня жизни. Наряду со всем этим, наука является не только движущей силой технологического прогресса, но и важным социальным и гуманитарным институтом, оказывающим значительное влияние на все сферы общественной жизни. Развитие страны, ее

конкурентоспособность и глобальное положение напрямую зависят от состояния и перспектив интеллектуальных ресурсов. Вышеизложенное обосновывает актуальность изучения данной темы.

Цель данной статьи – изучение проблем конкурентоспособности научного сектора РА. Для достижения этой цели в работе были поставлены следующие задачи: изучение текущего состояния развития научного сектора РА, анализ видов финансирования научного сектора, изучение субиндекса «утечка мозгов» в разные годы, выявление основных причин этой утечки и разработка мер, направленных на ее устранение.

На основании полученных результатов было подчеркнуто следующее: предотвращение утечки мозгов возможно за счет предоставления конкурентоспособных зарплат, социальных гарантий и возможностей для профессионального развития научных кадров.

Существенным препятствием для развития науки в Армении является низкий объем финансирования со стороны частного или коммерческого сектора, который играет важную роль в развитой научной системе, о чем свидетельствуют показатели, зафиксированные в разных странах мира. В Армении связь между государством, наукой и экономикой все еще слаба, что является существенным препятствием для коммерциализации научных результатов.

Ключевые слова: наука, ВВП, научные исследования, расходы на исследования, финансирование, «утечка мозгов».

CHALLENGES TO THE COMPETITIVENESS OF THE SCIENCE SPHERE IN ARMENIA

YEVGENYA HAKOBYAN

Abstract

Scientific research drives technological advancement, which directly enhances productivity and stimulates economic growth. Empirical studies indicate that the expansion of scientific output, such as publications, patents, and investments in research and development, leads to technological innovations, which in turn contribute to GDP growth and improvements in living standards. Today, science is not only a driver of technological progress but also a critical social and humanitarian institution, exerting a significant influence across all spheres of societal life. A country's development, competitiveness, and global standing are directly dependent on the state and potential of its intellectual resources. This underscores the importance, urgency, and relevance of studying this topic.

The aim of this article is to examine the challenges to the competitiveness of Armenia's scientific sector. To achieve this objective, the study sets the following tasks: to investigate the current state of the development of Armenia's scientific sector; to

analyze the types of financing for science; to examine the “brain drain” sub-index over different years and its main causes; and to develop measures to mitigate these issues.

Based on the analysis, the following recommendations can be made: it is essential to prevent brain drain by providing competitive salaries, social guarantees, and professional development opportunities for scientific personnel. Another significant obstacle to the development of science in Armenia is the limited financing from the private or business sector, which plays a crucial role in establishing a well-developed scientific system, as evidenced by global examples. Furthermore, the weak linkage between the state, science, and the economy in Armenia remains a significant barrier to the commercialization of scientific results.

Keywords: Science, GDP, scientific research, research expenditure, funding, brain drain.