AMERICAN JOURNALS
Open Access, Peer Reviewed Journals

American Journal of Business Management, Economics and Banking
ISSN (E): 2832-8078 Volume 48, May - 2026

WAYS TO IMPROVE SCIENCE FINANCING

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ABSTRACT

This study examines the content and significance of the science-financing system and its role in national economic development. It analyses the existing sources of financial support for research activity, the efficiency of using state-budget resources, and the possibilities for attracting private investment to science. Particular attention is paid to grant-based funding of research projects, commercialization of research outputs, and the development of innovation activity. The empirical part of the study also evaluates the institutional expansion of higher education in Uzbekistan during 2017-2026, including changes in the number and structure of higher education institutions, regional student distribution, and higher education coverage. Based on the results, proposals are formulated to diversify funding sources, improve the efficiency and transparency of resource allocation, strengthen science-business cooperation, and expand the practical application of research outcomes. These directions are intended to enhance scientific capacity and support economic competitiveness.

KEYWORDS

Science, financing, innovation, investment, grant, state budget, research and development, commercialization, scientific capacity, innovative development.

Introduction

In the contemporary global economy, intensifying competition, the rapid development of digital technologies, and the expansion of innovation processes have further increased the importance of science in societal development. The long-term economic stability and competitiveness of any country depend, first of all, on its scientific capacity, its ability to generate new knowledge, and its capacity to implement that knowledge in practice. Therefore, financial support for science and innovation is one of the important directions of public policy. [1], [2]

Science financing creates the conditions not only for carrying out research and development, but also for creating new technologies, training highly qualified specialists, developing research infrastructure, and introducing scientific developments into production. The availability of sufficient and stable financial resources enables researchers to use modern equipment, laboratories, and information resources, participate in international research projects, and transform innovative ideas into practical outcomes. [1], [3]

In Uzbekistan, considerable attention has also been paid in recent years to the development of science and innovation. Measures have been implemented to strengthen the material and technical base of research organizations and higher education institutions, finance research projects, support young

scientists, and commercialize research results. At the same time, issues such as the efficient use of funds, diversification of financing sources, attraction of private-sector resources, and evaluation of research-project performance remain relevant. [2], [4]

From this perspective, improving the mechanisms of science financing requires not only more efficient use of state-budget resources but also wider application of grants, venture capital, private investment, and international financial sources. Accelerating the transfer of research results to the real sector of the economy also requires stronger cooperation between science and production. [5], [2]

The relevance of the topic is determined by the fact that an effective financing system can strengthen scientific capacity, accelerate innovation activity, and increase the contribution of science to economic development. Accordingly, the purpose of this study is to assess the existing institutional and financial context of science development and to identify practical directions for improving science-financing mechanisms without altering the substantive priorities of the sector.

2. LITERATURE REVIEW

The OECD Frascati Manual provides the internationally recognized conceptual framework for identifying, classifying, and measuring research and experimental development. It emphasizes that R&D can be performed and financed across the government, business, higher education, and private non-profit sectors, and that public support may take different forms, including direct funding and indirect incentives. This framework supports a comprehensive view of science financing in which the sustainability of research depends on the interaction of several institutional sources rather than on a single funding channel. [1]

Hall and Lerner show that R&D and innovation frequently face a financing gap because uncertainty, information asymmetry, intangible assets, and long payback periods raise the cost of external capital, especially for young and innovative firms. Their findings also indicate that venture capital can mitigate only part of this problem and cannot fully substitute for broader financial-market and public-support mechanisms. This argument strengthens the rationale for combining public funding with private investment, grants, and commercialization-oriented instruments. [5]

Stephan demonstrates that economic incentives, competition for resources, and institutional funding rules significantly shape the behavior of researchers and research organizations. From this perspective, the effectiveness of science financing depends not only on the volume of resources allocated but also on how those resources are distributed, evaluated, and linked to research careers, infrastructure, and expected results. [3]

The UNESCO Science Report documents the expansion of global research expenditure and researcher numbers while also highlighting large differences in research intensity across countries and regions. For Central Asia, the report points to persistent underinvestment in R&D and emphasizes competitive grants, modern research equipment, international cooperation, and an improved innovation environment as important responses. In parallel, Bloom, Jones, Van Reenen, and Webb find that research effort has increased substantially in many fields while research productivity has declined, implying that the efficiency of resource allocation and the quality of research management are as important as the scale of financing. Together, these studies support a diversified, transparent, and results-oriented approach to science financing. [2], [6]

3. RESEARCH METHODOLOGY

The study uses a descriptive and comparative analytical approach. The methodological toolkit includes document analysis, dynamic analysis, structural-share analysis, and calculation of growth rates and proportional changes. The conceptual interpretation of science financing is based on internationally accepted approaches to R&D measurement and funding, while the empirical analysis relies on the statistical series contained in the original manuscript and official reporting materials of the Ministry of Higher Education, Science and Innovation of the Republic of Uzbekistan. [1], [4]

The empirical period covers 2017-2026. The analysis examines: (i) the regional distribution of higher education institutions and students as of 20 June 2026; (ii) changes in the total number of state, non-state, and foreign higher education institutions; and (iii) higher education coverage over time. Percentage shares, absolute changes, and fold changes are calculated from the reported data. Because the research design is descriptive, the results identify institutional trends and financing-related implications but do not establish causal relationships.

4. ANALYSIS AND DISCUSSION OF RESULTS

The development of the higher education system is one of the important factors shaping a country's human capital, scientific and technical capacity, and innovative economy. In particular, the regional location of higher education institutions, the ratio between state, non-state, and foreign institutions, and the structure of the student population make it possible to assess the institutional environment in which scientific and educational activities are financed. As of 20 June 2026, 207 higher education institutions were operating in the republic, including 101 state, 74 non-state, and 32 foreign institutions. These figures indicate a growing role for the non-state and foreign sectors in the higher education services market. At the same time, the regional distribution of students shows that demand for higher education is geographically uneven. Therefore, analysing the relationship between the location of higher education institutions and student populations is important for the more efficient organization of educational and research infrastructure. [4]

Table 1. Higher Education Institutions in the Republic as of 20 June 2026

No.	Region	Total HEIs	State	Non-state	Foreign	Total students	State	Non-state	Foreign
	TOTAL	**207**	**101**	**74**	**32**	**1,625,934**	**956,133**	**629,193**	**40,608**
1	Republic of Karakalpakstan	11	9	2		77,530	56,938	20,592	
2	Andijan Region	9	6	1	2	67,786	60,226	6,330	1,230
3	Bukhara Region	10	4	6		122,374	57,325	65,049	
4	Jizzakh Region	5	3	1	1	32,099	29,461	1,648	990
5	Kashkadarya Region	9	3	6		121,110	45,640	75,470	
6	Navoi Region	4	2	2		40,415	27,735	12,680	
7	Namangan Region	7	4	3		87,040	44,991	42,049	
8	Samarkand Region	14	13	1		92,837	92,400	437	
9	Surkhandarya Region	6	5	1		82,254	51,462	30,792	
10	Syrdarya Region	3	3			23,124	23,124		
11	Tashkent Region	18	8	5	5	76,370	49,066	22,375	4,929
12	Fergana Region	9	5	3	1	100,037	68,844	30,977	216
13	Khorezm Region	8	5	3		68,336	41,160	27,176	
14	Tashkent City	94	31	40	23	634,622	307,761	293,618	33,243

Source: Author's calculations based on the data presented in the original manuscript and official Ministry reporting materials [4].

According to the data as of 20 June 2026, a total of 1,625,934 students were enrolled in higher education institutions in Uzbekistan. Of these, 956,133 studied in state institutions, 629,193 in non-state institutions, and 40,608 in foreign institutions. Calculations show that approximately 58.8 percent of all students were enrolled in state institutions, 38.7 percent in non-state institutions, and 2.5 percent in foreign institutions. This means that although the state sector retains the leading position, non-state institutions have acquired substantial capacity in the provision of higher education services. [4]

There are substantial differences across regions in the number of higher education institutions and students. The largest values are observed in Tashkent City, where 94 institutions serve 634,622 students. The capital accounts for approximately 45.4 percent of all higher education institutions in the republic and nearly 39 percent of the total student population. This reflects Tashkent City's role as the country's principal educational, research, and intellectual center. At the same time, the presence of 40 non-state and 23 foreign higher education institutions in the capital indicates that diversification of the education-services market is especially advanced in this area.

Tashkent Region is among the next largest areas with 18 higher education institutions and 76,370 students. Samarkand Region has 92,837 students in 14 institutions, Bukhara Region 122,374 students in 10 institutions, Kashkadarya Region 121,110 students in 9 institutions, and Fergana Region 100,037 students in 9 institutions. The relatively large student populations in these regions are associated with population size, demand for higher education, institutional capacity, and the level of regional economic activity.

The regional distribution of non-state higher education institutions also deserves particular attention. Kashkadarya Region has 6 non-state institutions with 75,470 students. Bukhara Region also has 6 non-state institutions with 65,049 students, Tashkent Region has 5 institutions with 22,375 students, while Surkhandarya Region has 1 non-state institution with 30,792 students. These figures demonstrate that the pace and scale of non-state higher education development are not uniform across regions.

Foreign higher education institutions are concentrated mainly in major economic and educational centers. Tashkent City hosts 23 foreign institutions with 33,243 students. Tashkent Region has 5 foreign institutions with 4,929 students, Andijan Region 2 institutions with 1,230 students, Jizzakh Region 1 institution with 990 students, and Fergana Region 1 institution with 216 students. These indicators show a relatively high territorial concentration of foreign education providers.

In some regions, the student population is comparatively large despite a small number of higher education institutions. For example, Bukhara Region has 122,374 students across 10 institutions and Kashkadarya Region has 121,110 students across 9 institutions. By contrast, Navoi Region has 40,415 students in 4 institutions and Syrdarya Region has 23,124 students in 3 institutions. This indicates substantial differences in the average number of students per institution across regions.

Overall, the data indicate territorial concentration within the higher education system. Tashkent City differs markedly from other regions not only in the number of institutions but also in the development of the non-state and foreign education sectors. The gap between the availability of higher education and student demand across regions requires a differentiated approach to locating new institutions, using existing capacity efficiently, and improving the quality of educational services. From the perspective

of science financing, such institutional concentration also implies that research infrastructure and funding instruments should take regional capacity and demand into account.

The institutional development of higher education is an important condition for building human capital, strengthening scientific capacity, and training qualified specialists for modern sectors of the economy. Data for 2017-2026 make it possible to assess the scale of this process. In particular, the increase in the number of higher education institutions from 77 to 207 indicates substantial institutional expansion. [4]

Table 2. Number of Higher Education Institutions in 2017-2026

Indicator	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026*
Total number of HEIs	77	90	108	122	159	209	211	203	207	207
State HEIs	70	78	83	91	103	114	112	102	101	101
Branches of foreign HEIs	7	12	5	9	26	30	30	30	32	32
Non-state HEIs			20	22	30	65	69	71	74	74

Source: Original manuscript data; 2026 values are reported as of 20 June 2026. Official reporting materials confirm the 2026 institutional structure [4].

Between 2017 and 2026, the number of higher education institutions in Uzbekistan increased from 77 to 207. Thus, over the ten-year period, the number rose by 130 institutions, or approximately 2.7 times. The strongest growth occurred in 2020-2022: the number increased from 122 institutions in 2020 to 159 in 2021 and 209 in 2022. This was a period of especially rapid expansion of the higher education system and entry of new providers into the education-services market.

In 2017, state institutions constituted the dominant part of the higher education system, numbering 70. By 2026, their number had increased to 101. Thus, the number of state higher education institutions rose by 31, or 44.3 percent. However, the overall number of higher education institutions grew faster than the state segment. As a result, the relative share of state institutions declined from approximately 90.9 percent in 2017 to 48.8 percent in 2026.

One of the principal drivers of this structural change was the rapid development of non-state higher education institutions. There were 20 non-state institutions in 2019, 22 in 2020, 30 in 2021, and 65 in 2022. Their number reached 69 in 2023, 71 in 2024, and 74 in both 2025 and 2026. Accordingly, between 2019 and 2026, the number of non-state institutions increased by 54, or approximately 3.7 times. In 2026, non-state institutions represented about 35.7 percent of all higher education institutions.

Branches of foreign higher education institutions also played an important role in institutional diversification. Their number was 7 in 2017 and increased to 12 in 2018. After declining to 5 in 2019, the number rose to 9 in 2020, 26 in 2021, and 30 in 2022-2024. In 2025-2026, the number of foreign branches reached 32. As a result, their number increased by 25, or approximately 4.6 times, between 2017 and 2026.

The number of higher education institutions reached 209 in 2022 and then increased to 211 in 2023, the maximum level in the period under review. Although the number declined to 203 in 2024, it returned to 207 in 2025 and remained at that level in 2026. This pattern suggests that changes in the

number of institutions may reflect not only the establishment of new organizations but also reorganization, changes in status, or broader institutional restructuring.

Overall, the 2017-2026 dynamics show that the higher education system changed not only in size but also in institutional composition. State institutions initially had an absolute predominance; later, the expansion of non-state and foreign providers produced a multi-provider model in the higher education services market. This development increases the importance of quality assurance, competition, alignment of educational programs with labor-market needs, effective governance, and sustainable financing mechanisms for teaching and research.

Higher education coverage is an important socio-economic indicator for assessing young people's access to tertiary education. Growth in this indicator reflects the expansion of educational infrastructure, the increase in the number of higher education institutions, and greater access to educational services.

Table 3. Higher Education Coverage in 2017-2026

Indicator	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026*
Higher education coverage, %	9	15	20	25	29	38	42	42	44	44

Source: Original manuscript data; official Ministry reporting confirms that higher education coverage increased from 9 percent to 44 percent [4].

Higher education coverage in Uzbekistan increased consistently during 2017-2026. The indicator rose from 9 percent in 2017 to 15 percent in 2018, 20 percent in 2019, and 25 percent in 2020. Growth continued in subsequent years, reaching 29 percent in 2021, 38 percent in 2022, and 42 percent in 2023. Coverage remained at 42 percent in 2024, increased to 44 percent in 2025, and stayed at 44 percent in 2026. Overall, higher education coverage rose by 35 percentage points over the period, or approximately 4.9 times. Growth was particularly strong during 2017-2023. [4]

This trend coincided with a substantial increase in both the number of higher education institutions and the student population. The stabilization of coverage at 44 percent in the most recent years means that further policy attention should extend beyond quantitative expansion to the quality of education, the efficient use of existing resources, and the capacity of institutions to support research and innovation.

The increase in higher education coverage from 9 percent to 44 percent demonstrates a major expansion of access. In particular, the rise from 38 percent in 2022 to 44 percent in 2025 is an important result. In the future, alongside further expansion of access, priority should be given to education quality, staff capacity, research infrastructure, and the competitiveness of graduates in the labor market. These objectives also require a financing system that links resource allocation to institutional performance and measurable outcomes.

5. CONCLUSIONS AND RECOMMENDATIONS

Science financing is an important factor in economic, social, and technological development. Adequate and stable investment in research and innovation supports the creation of new knowledge and technologies, strengthens scientific capacity, and contributes to sustainable economic growth. The analysis also shows that the institutional base of higher education in Uzbekistan expanded substantially between 2017 and 2026: the number of institutions increased from 77 to 207, the role of non-state and

foreign providers grew, and higher education coverage increased from 9 percent to 44 percent. These trends broaden the organizational base for research activity but simultaneously increase the need for efficient, transparent, and diversified financing mechanisms. [2], [4]

The main financing sources considered in the study include state-budget resources, grants, international organizations and foreign investors, private-sector investment, and income generated through the commercialization of research results. Their coordinated use can strengthen the financial sustainability of research organizations and improve the practical effectiveness of research. At the same time, the literature shows that private financing alone does not fully resolve the R&D financing gap, which reinforces the need for balanced public and private participation. [5]

Based on the findings, the following recommendations are proposed: (1) establish long-term and stable financing mechanisms for priority research areas; (2) improve the efficiency of state-budget allocations through transparent and competitive project selection, clear performance indicators, and stronger monitoring of fund use; (3) expand private-sector participation through co-financing, venture-finance instruments, and incentives for enterprise investment in R&D; (4) strengthen cooperation among universities, research organizations, and business entities, including patenting and commercialization of research outputs; (5) expand grants, scholarships, research internships, and international project opportunities for young scientists; and (6) direct infrastructure and research-support resources in a differentiated manner that reflects regional institutional capacity, student demand, and the distribution of higher education institutions. [1], [2], [3], [5]

In general, improving science financing requires stronger cooperation among the state, private sector, higher education institutions, and research organizations. Diversification of funding sources, efficient resource use, rigorous evaluation of scientific results, and wider implementation of research outputs in practice can enhance the country's scientific and innovation capacity. In this way, science can make a stronger contribution to economic growth, social well-being, and international competitiveness.

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