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Article

Improving The Mechanism Of Financing Innovation Activity In Enterprises: International Benchmarking And Scenario Assessment

Umarova Iroda Sadriddinovna[1]

1. *Independent Researcher at the Banking and Finance Academy of the Republic of Uzbekistan.*

* Correspondence : umarova.iroda@gmail.com

Abstract: This article examines mechanisms for financing innovation in Uzbek enterprises through international benchmarking and scenario analysis. Using Global Innovation Index 2025 indicators and national statistics for 2020–2024, the study identifies low R&D intensity (0.1% of GDP), limited credit availability (34.7% of GDP), and negligible venture investment, despite a 42.4% business contribution to R&D financing. Three financing scenarios to 2030 are assessed, highlighting the need for accelerated investment. The study proposes a stage-based financing framework integrating appropriate instruments across research, development, commercialisation, and scaling.

Keywords: innovation financing, enterprises, R&D expenditure, venture capital, credit, Global Innovation Index.

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1. Introduction

The mechanism of financing innovation activity in enterprises is the set of sources, instruments, institutions and rules through which resources are mobilised for the creation and market introduction of new products, processes and organisational solutions. Its design is decisive for the innovation performance of firms, because the characteristics of innovation projects – intangible results, high uncertainty and strong information asymmetry – make them difficult to finance through standard market channels. The pecking-order theory explains why firms with such projects prefer internal funds, then debt and only as a last resort external equity [1], and empirical studies confirm that the cost of external capital for R&D is systematically higher than for ordinary investment [2]. Financing constraints reduce the probability that a firm starts or continues an innovation project [3],[4], and the effect is strongest for small and medium-sized enterprises [5].

At the same time, the international experience demonstrates that an appropriate architecture of the financing mechanism can substantially relax these constraints. Venture capital has been found to be several times more effective per dollar than corporate R&D in generating patented innovations [6], and the diversification of financing instruments for small and medium-sized enterprises is now a standard element of national innovation and entrepreneurship policies [7]. For Uzbekistan, which is implementing a strategy of innovative development and aims to enter the top 50 of the Global Innovation Index, the question of how the financing mechanism should be improved is therefore of direct practical importance.[8] The country has made progress in the overall ranking, reaching 79th place in 2025, but the finance-related indicators lag far behind, with 107th place in the investment pillar and 98th place in R&D intensity [9].

The purpose of the research is to identify the structural weaknesses of the mechanism of financing innovation activity in Uzbek enterprises through international benchmarking and to substantiate the directions for its improvement using scenario assessment. The tasks are to compare the finance-related innovation indicators of Uzbekistan with those of selected economies, to assess the structure of innovation expenditure, to compute scenarios of R&D financing to 2030 and to propose a stage-based set of financing instruments. The scientific novelty consists in the combination of cross-country benchmarking with scenario modelling, which allows the gap between the current and the required level of financing to be expressed quantitatively and the instruments for closing it to be linked to specific stages of the innovation cycle.

2. Materials and Methods

The information base of the research includes two sources. The first is the set of economy profiles of the Global Innovation Index 2025 published by the World Intellectual Property Organization, from which the following indicators were extracted for six economies: the overall rank, the credit pillar score and rank, domestic credit to the private sector as a share of GDP, the investment pillar score and rank, gross expenditure on R&D as a share of GDP and the share of R&D financed by business [9]. Kazakhstan and Kyrgyzstan were included as neighbouring economies with a similar institutional background, Georgia as a reform-oriented post-Soviet economy with a developed banking sector, and Türkiye and Viet Nam as middle-income economies that have reached the upper half of the ranking and may serve as benchmarks. The second source is the official statistics of Uzbekistan on R&D expenditure, innovation costs and innovative output for 2020–2024 [10].

Four methods are used. Comparative analysis positions Uzbekistan against the comparison group for each indicator. The index method is applied to relate the national value of each indicator to the best value in the group, which gives a normalised measure of the gap. The structural analysis of innovation expenditure distinguishes R&D from non-R&D innovation costs (acquisition of machinery, equipment and software, engineering, training and marketing) in accordance with the Oslo Manual approach. Scenario extrapolation projects R&D expenditure to 2030 under three assumptions about the average annual growth rate. The inertial scenario keeps the compound annual growth rate observed in 2020–2024 (17.1 per cent). The accelerated scenario assumes 25 per cent, which corresponds to the best years of the observed period. The strategic scenario assumes 35 per cent, which is the rate needed to approach the R&D intensity targets of the national strategy by the end of the decade. Finally, a qualitative assessment of financing instruments by stage of the innovation cycle is carried out on the basis of the literature and the results of the benchmarking. The projections are in current prices and do not account for inflation.

3. Results

The results of the international benchmarking are summarised in Table 1, which presents the finance-related indicators of the Global Innovation Index 2025 for Uzbekistan and five comparison economies.

Table 1

Finance-related indicators of the Global Innovation Index 2025 for Uzbekistan and comparison economies

Economy	GII rank	Credit pillar, score (rank)	Domestic credit to private sector, % GDP	Investment pillar, score (rank)	R&D expenditure, % GDP	R&D financed by business, %
Uzbekistan	**79**	**34.8 (48)**	**34.7**	**1.3 (107)**	**0.10**	**42.4**
Kazakhstan	81	19.3 (96)	26.0	2.6 (90)	0.14	47.4
Kyrgyzstan	96	19.4 (95)	21.6	n/a	0.06	6.9
Georgia	56	36.9 (42)	66.1	3.1 (85)	0.25	1.7
Türkiye	43	37.4 (41)	49.6	5.2 (69)	1.42	52.6
Viet Nam	44	32.5 (59)	125.9	6.8 (62)	0.42	64.1

Source: compiled by the author on the basis of [9]. Note: n/a – data not available; the values for the share of R&D financed by business for Uzbekistan, Kazakhstan and Kyrgyzstan refer to the latest available year.

Three observations follow from Table 1. First, in terms of the credit pillar Uzbekistan performs better than its Central Asian neighbours and is close to Georgia and Türkiye, which reflects the rapid development of the banking sector in recent years. However, the

depth of the credit market measured by domestic credit to the private sector (34.7 per cent of GDP) remains well below Georgia (66.1 per cent) and Viet Nam (125.9 per cent), which limits the volume of long-term lending available for innovation. Second, the investment pillar is the weakest element in all Central Asian economies, but Uzbekistan has the lowest score in the group (1.3), which is five times lower than Viet Nam and four times lower than Türkiye. Third, the share of R&D financed by business in Uzbekistan (42.4 per cent) is comparable with Kazakhstan and Türkiye and far above Georgia and Kyrgyzstan, but it is combined with R&D intensity of only 0.10 per cent of GDP. In other words, enterprises already finance a large part of a very small research effort. The comparison of the business share in R&D financing is shown in Figure 1.

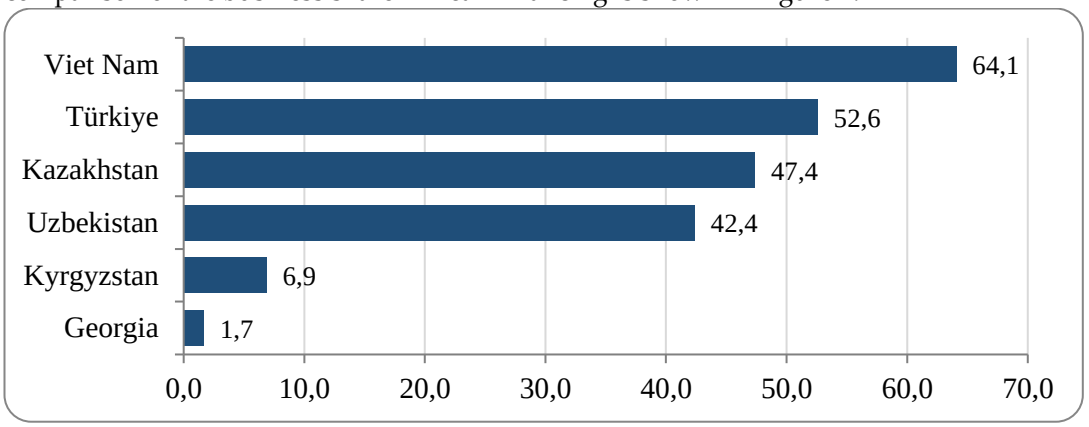


Figure 1. Share of R&D financed by the business sector in selected economies, %
Source: compiled by the author on the basis of [9].

The index method makes the gap explicit. If the best value in the group is taken as 100, Uzbekistan reaches 93 points in the credit pillar, 28 points in domestic credit to the private sector, 19 points in the investment pillar, 7 points in R&D intensity and 66 points in the business share of R&D financing. The profile of the national financing mechanism is thus highly uneven: bank credit is relatively mature, the equity and venture channel is embryonic, and the overall scale of R&D financing is an order of magnitude below the benchmark.

The second block of results concerns the structure of innovation expenditure of enterprises. According to official statistics, in 2024 R&D expenditure amounted to 1,574.1 billion soums, while total innovation costs of enterprises, including technological, marketing and organisational innovation, reached 9,739.3 billion soums [10]. Hence R&D represented only about 16 per cent of total innovation costs, and the remaining 84 per cent was spent predominantly on the acquisition of machinery, equipment, software and other forms of embodied technology. Such a structure is typical for catching-up economies, where innovation is based mainly on technology transfer, and it has important implications for the financing mechanism, because the acquisition of equipment can be financed by bank loans and leasing against tangible collateral, whereas the research component, which is small today but must grow, requires instruments that do not rely on collateral. In 2024 innovation costs declined by 8.3 per cent relative to 2023, whereas R&D expenditure grew by 13.3 per cent, so the share of research in innovation financing is gradually increasing.

The third block of results presents the scenarios of R&D financing to 2030, which are shown in Figure 2. Under the inertial scenario R&D expenditure reaches about 4.1 trillion soums in 2030, under the accelerated scenario about 6.0 trillion soums and under the strategic scenario about 9.5 trillion soums. The difference between the inertial and the strategic trajectory exceeds 5 trillion soums in 2030 alone, which illustrates the scale of additional resources to be mobilised. Since nominal GDP is also expected to grow, only the strategic scenario would raise R&D intensity to a level approaching 0.3–0.4 per cent of GDP, which corresponds to the position of Viet Nam and Georgia in the benchmarking group, while the inertial scenario would leave R&D intensity practically unchanged.

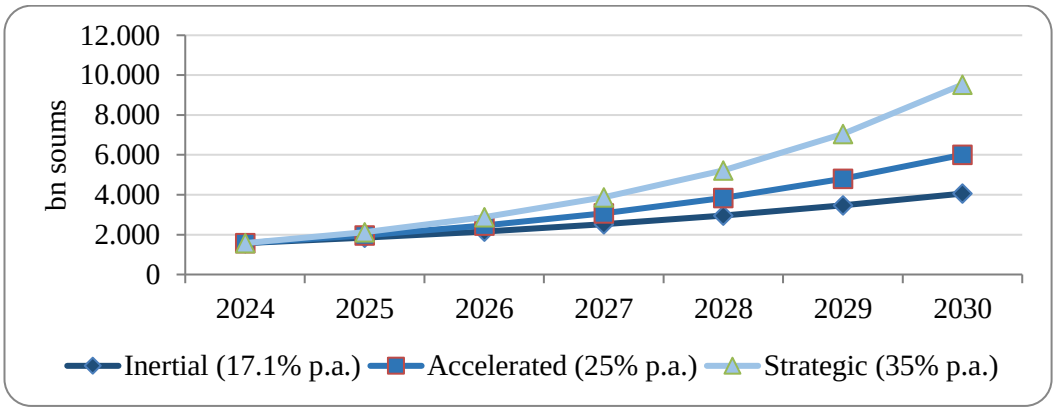


Figure 2. Scenarios of R&D expenditure in Uzbekistan to 2030, bn soums (current prices)

Source: calculated and built by the author on the basis of [10].

The fourth block of results is a stage-based assessment of financing instruments, presented in Table 2, which identifies for each of the four stages of the innovation cycle the dominant source, the recommended instruments and the main precondition for their application.

Table 2

Stage-based architecture of the mechanism of financing innovation activity in enterprises

Stage of the innovation cycle	Nature of financing need	Dominant source	Recommended instruments	Key precondition
Research (idea, applied research)	Small amounts, very high uncertainty, no collateral	Own funds, public grants	Innovation development fund of the enterprise; competitive grants; incremental R&D tax credit	Transparent grant procedures; tax accounting of R&D
Development (prototype, testing)	Medium amounts, high uncertainty, intangible results	Own funds, equity	Co-financing of joint projects with research organisations; business angels; public-private seed fund	Protection of intellectual property; valuation of intangible assets
Commercialisation (market launch)	Large amounts, moderate risk, partly tangible assets	Equity, guaranteed debt	Venture fund with fund-of-funds structure; state guarantees on innovation loans; leasing of equipment	Exit opportunities for investors; long-term bank resources
Scaling (expansion of output)	Large amounts, lower risk, tangible collateral	Bank credit, capital market	Investment loans; corporate bonds; listing on the growth segment of the stock exchange	Depth of the credit market; investor base on the stock exchange

Source: compiled by the author on the basis of [1], [6],[8] and the results of the benchmarking.

4. Discussion

The results allow the weaknesses of the existing financing mechanism to be formulated more precisely than in the general terms of insufficient resources. The benchmarking shows that the mechanism is not weak in all respects: the credit channel is comparable with that of economies ranked considerably higher, and the willingness of enterprises to

finance R&D from their own funds is also relatively high. The weaknesses are concentrated in two places. The first is the absence of an equity and venture channel, which is reflected in the investment pillar score of 1.3 and in the negligible number of venture deals. The second is the small overall scale of R&D financing, which the inertial growth trajectory does not change.

These two weaknesses are interrelated. The theoretical literature explains that debt is poorly suited to financing the research and development stages, because the lender cannot evaluate the project, cannot take the intangible result as collateral and does not share in the upside of success [11],[12]. In the absence of equity instruments, enterprises limit research to what can be financed from current profit, which is precisely the pattern revealed by the combination of a high business share and low intensity of R&D. The development of venture and seed financing is thus the key to unlocking the growth of research expenditure, and the evidence on the high innovation productivity of venture capital [13] suggests that the return on such investment can be substantial.

The stage-based architecture proposed in Table 2 translates this conclusion into a set of instruments. Its central idea is that each stage of the innovation cycle should have its own source and instrument, so that the enterprise does not have to use bank credit, which is adequate only for the scaling stage, to finance research and development. At the research stage the mechanism relies on the enterprise's own innovation fund, supported by an incremental tax credit, and on competitive public grants. At the development stage co-financing of joint projects with research organisations and a public-private seed fund are introduced. At the commercialisation stage a venture fund with a fund-of-funds structure, state guarantees on innovation loans and equipment leasing are applied, and at the scaling stage the enterprise moves to investment loans, corporate bonds and the growth segment of the stock exchange. International experience confirms that such a combination of grants, guarantees, equity and debt is more effective than any single instrument [8].

The scenario assessment shows that the improvement of the mechanism must be ambitious. The accelerated scenario, which only repeats the best years of the recent past, raises R&D expenditure to about 6 trillion soums by 2030 but does not change R&D intensity significantly. The strategic scenario requires sustained growth of 35 per cent per year, which cannot be achieved by budget financing alone and presupposes that enterprises and private investors contribute the larger part of the increment. The policy conclusion is that public resources should be used as a lever for private financing rather than as its substitute, through co-financing requirements, guarantees and fund-of-funds structures.[14]

The research has limitations. The benchmarking is based on a small comparison group and on index data, part of which refer to earlier years, the scenarios are expressed in current prices, and the stage-based assessment of instruments is qualitative. Further research should estimate the effect of financing constraints on innovation activity at the level of individual enterprises using survey or panel data, as has been done for other economies [15].

5. Conclusion

The research has shown that the mechanism of financing innovation activity in enterprises of Uzbekistan has an uneven profile. The credit channel and the business share of R&D financing are comparable with those of economies ranked considerably higher in the Global Innovation Index, whereas the equity and venture channel is practically absent and the overall scale of R&D financing, at 0.1 per cent of GDP, is an order of magnitude below the benchmark. R&D accounts for only about 16 per cent of total innovation costs of enterprises, which means that innovation is still based mainly on the acquisition of embodied technology.

The scenario assessment demonstrates that the inertial trajectory of R&D financing does not change this position by 2030, and that only the strategic scenario with growth of about 35 per cent per year brings R&D intensity close to the level of the benchmark economies. The improvement of the financing mechanism should therefore be based on a stage-based architecture that assigns own funds and grants to the research stage, co-

financing and seed capital to the development stage, venture capital, guarantees and leasing to the commercialisation stage, and bank credit and the capital market to the scaling stage. Implementation of this architecture, in which public resources leverage private investment, would create the conditions for enterprises to expand their own research and to move from technology transfer to the generation of innovations.

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