



Innovation Policy Coordination: The Role of Communication for Uzbekistan

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Abstract:

The relative importance of various drivers of economic growth and prosperity has evolved over time, and innovation is the primary driver of economic growth for a growing number of countries. Innovations can be developed in countries where the state innovation policy is effectively implemented, and the state coordinates the subjects of innovation policy. The coordination requires integration, digitalization and sharing of information across departments and sectors. The objective of this paper is to describe how Uzbekistan's innovation system has evolved during the last decade since Uzbekistan moved from a highly regulated mixed economy to an open market economy. In this process, we start by describing the national innovation system of Uzbekistan, describe some of the key changes in the innovation policy coordination system, the legal acts of reforming the public administration, the bodies responsible for the implementation of laws, monitoring and evaluating the fulfillment of the set strategic tasks. Then we will reveal the state's role in coordinating and establishing an effective national innovation policy, reveal the theoretical aspects and compare them with the implementation in Uzbekistan. For these purposes, data from open and transparent sources from 2009 to 2021 are analyzed, and the impact of various factors on Uzbekistan's economic and innovative development using econometric analysis is evaluated. The conclusion of the research consists of the recommendations that are given in order to improve the state innovation policy, establish communication and achieve the goals of the government.

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Keywords:

coordination of innovation policy, innovation policy in Uzbekistan, interaction in terms of the national innovation system, triple helix model of innovation

1. Introduction

A well-thought-out and balanced innovation policy plays a vital role in the modernization of Uzbekistan's policy and economy since it influences the prosperity and development of the country. With this in mind, innovation policy must consider not only the interests of individual research institutes and corporations but also the interests of all economic entities. At the same time, innovation policy should consider the experience that highly developed countries have already implemented to have an up-to-date vision of innovation policy and to learn from the mistakes that other countries have faced.

The innovative development of Uzbekistan relies not only on the country's economic growth but also on improving citizens' quality of life. Reforms in innovation policy should form the National Innovation System (NIS), which establishes interactions among research institutes, industries, and government. The state, to establish an effective national innovation system, needs to develop a wide range of factors, policies, and institutions that have a bearing on strengthening innovation in a large number of countries, including their institutional environment, the regulatory and legal framework, and special attention is paid to coordination (Zhang et al., 2019).

This paper develops an R&D-based growth model, according to which innovation is created in R&D sectors and generates sustainable economic growth if the returns to innovation in the R&D part are constant (Ulku, 2004). In addition to R&D, the paper also looks at indicators of infrastructure development, the number of collaborative innovation partnerships, the amount of research and other government-influenced indicators collected from open international sources, local statistical portals, and ministry data.

Exploring Uzbekistan's innovation policy over the last decade, the following research questions are brought up in the article: (1) Has the coordination system been successfully implemented in Uzbekistan's innovation policy? (2) What are the main factors of public administration influencing the development of innovations in Uzbekistan? (3) What lessons can be learned from the experience of Uzbekistan, and can other countries use this experience?

The article analyzes various data on the country to answer these questions. Also, it uses an econometric model tool that examines a broad array of factors, policies, and institutions that have a bearing on strengthening innovation in Uzbekistan, including the institutional environment, the regulatory and legal framework, the infrastructure for research and development, and the adoption and other data from open sources. The

primary aim is to identify the factors that contribute to the innovative development of Uzbekistan and identify the most effective mechanisms of the state innovation policy. As will be shown, the reforms and changes taking place over the past ten years have played an essential role in developing innovation in the country. The article uses data from international open databases, local ministries, and statistical portals. The results of these reforms are already noted in the Global Innovation Index 2022. Successful mechanisms of innovation development in Uzbekistan and experience can be used by countries that focus on innovative economic development and avoid the country's problems in implementing reforms and modernization of the economy.

2. Theoretical framework: Overview of potential policy

When reaching the first objective, innovation has had many definitions and is a word used widely today. Thus, it was challenging to obtain an exact meaning. Some stated innovation as anything new, and others as responding to changes. In this case, it was chosen to use innovation as the definition used by Kirzner, which stated that innovation is making new products from old technology or new technology and making old products from old technology (lowering cost) or new technology (Kirzner, 2011). According to modern economic theory, innovation catalyzes the economy and promotes economic growth (Schumpeter, 2003). It is commonly believed that the primary goal of the state innovation policy is the development and implementation of innovative goods, services, methods or utility models (OECD, 2003). Innovative activity is associated with high risks, and therefore, there are market failures when the benefits to commercial firms are lower than the expenditure on research and development (R&D) of innovative products. A state interested in innovation and using the help of state support mechanisms solves market failures by providing financial and non-financial support to innovative companies and research centers whose technologies are socially crucial for both the state and society (Nelson, 1993).

Evaluation of the effectiveness of public programs for business support in Slovakia has shown a positive impact on the development of small and medium-sized innovative companies, the employment of the population, and the added value of production (Pisár et al., 2021). Although the study was based on data from one country for seven years, from 2007 to 2013, the study included an analysis of all the programs of the relevant ministry, and a survey was conducted with competent professionals. This study confirms the theory that the state is interested in innovative development for the economic and social development of the country as a whole.

According to panel research of OECD data, there is a positive relationship between per capita GDP and innovation in OECD countries. In contrast, the effect of R&D stock on innovation is significant only in the OECD countries with large markets (Ulku, 2004). In the research work (Usman et al., 2022), a large amount of data is analyzed

using regression analysis for the BRICS countries, where the author tries to compare the development of innovations in the countries with quantitative data and draws conclusions based on input and output indicators. According to the Castellacci and Natera (2013), analyzing internal dynamics of innovation capacity, technology output (patent), and scientific output has negative relationships but mutually have optimistic and significant associations with middle-income economies' per capita GDP income level. On the other hand, there is no negative association between R&D expenditure, science and technical articles, or patents of developed economies. Econometric research models should consider a specific period and should be comparable. Each model has limitations as it has subjectivity (Janger et al., 2017).

An innovative ecosystem that has become increasingly important and has a long history is the interaction between universities, industries, and governments. Combining these three parties has become essential for industries' continued growth and innovative mindset, referred to as the triple helix model (Chinta & Sussan, 2018; Leydesdorff & Etzkowitz, 1998). In an ecosystem, different parties act together to achieve their common goal. All the parties use resources, and the collaboration depends on all system members. An essential role for the state is monitoring and evaluating innovative projects. If the government funds the company, these administrative tasks rise even more. It requires a considerable effort to document and report the project's activities in order to receive the grants (Sedmihradská, 2019).

With limited budgetary funds, the effectiveness of state mechanisms is essential. Collaboration within NIS should be comprehensive, and for effectiveness, all participants should be involved and communicate with each other. The government also has its specific role in implementing decisions, possible legislative issues, and implications for strategy and policy, and these are direct stakeholders as they can provide case studies that should have a fresh, innovative solution that happens from the universities' point of view. Thus, the government's role in the Triple Helix model is often recognized as supportive and legislative, and the active role of the government in this form of partnership is recognized (Damnjanović et al., 2019).

However, given the specifics and country specifics, using analysis templates for more developed countries is impossible. In order to conduct its own analysis, focusing on the effective construction of state innovation policy, the role and mechanisms of public administration are considered. Next, we consider five key roles of the state in implementing and coordinating innovation policy:

1. The state can act as a customer of innovations, providing demand for new technologies and products

The state identifies areas that require innovative technologies for long-term sustainable development and places orders with private-sector companies, thereby stimulating the development and scaling of innovations in priority areas. Thus, the government shares financial responsibility for research success with the private sector,

acting as the final customer of the technology or product. The state order for innovation is a significant stimulus to the innovation activity of universities, research institutes, and companies in further distributing new technologies in various industries (Vilén, 2021).

In Uzbekistan, the government makes significant efforts to maintain demand for innovation by subsidizing innovative companies and directly placing orders for innovative products. Additional measures to increase demand for innovation could include introducing research and development co-financing programs and providing preferences and benefits for companies conducting research and development in priority areas. In addition, the state can play a significant role in creating demand for high-tech products from large businesses.

As a shareholder in the most prominent companies, the state can stimulate their involvement in systematic work on innovation with the help of a set of corporate governance tools. In particular, what can be considered are several indicators for assessing the effectiveness of innovations, such as:

- the share of innovative products in revenue;
- the contribution of innovations to profit growth;
- the size and structure of the portfolio of innovative projects;
- the presence of an innovative strategy and its quality;
- roadmaps for developing partnerships for innovation.

2. The state provides the environment and conditions for developing innovations in the country, creating the necessary infrastructure

The innovation infrastructure includes the education system, innovation clusters and special economic zones, innovation development agencies and institutions, intellectual property protection and the legal system, a standards system, certification and accreditation, an institutional environment, a favorable business environment, and fiscal policy (Baierle et al., 2021).

With significant state support, an infrastructure for innovation development has been created in Uzbekistan. However, a qualitative leap in innovation and entrepreneurship development has not yet been traced. Therefore, the potential for improving conditions still exists.

The key tasks of infrastructure improvement requiring focused attention include developing cooperation between science and industry, clarifying the development direction of specialized clusters and innovation development agencies, and stimulating the emergence of technology brokers and engineering centers on the market.

At the same time, the close interaction between science and business makes it possible to scale up and implement innovative ideas that arise in fundamental and applied research. For example, this area can be developed by creating consortiums and improving the effectiveness of platforms for dialogue on innovation between players from various industries, start-ups, and research institutions to exchange experiences

and technologies. Even though technology platforms already have this function, they often do not involve representatives of industry leaders, which is necessary for effective dialogue.

3. The state plays a vital role in funding innovative research

The state selectively finances basic and applied research that meet specific criteria (as a rule, these are priority areas for development) and other studies with significant potential. For instance, the US Department of Defense Advanced Research Projects Agency (DARPA) funds basic and applied research at various stages despite priority areas (for example, protection against chemical and biological weapons). Furthermore, it allocates grants for research development outside the military-industrial complex (Liu, 2020).

The state shares financial responsibility for research success with the private sector. It stimulates its development by creating and supporting the activities of grant funds, state funds, innovation support funds, and co-financing research. It also encourages the development of the market for private financing of innovations (e.g., venture funds). In addition, the government finances innovative projects in cooperation with companies from various industries, using the model of public-private enterprises and other forms of partnership between the state, business and society.

Since only a small part of innovative projects ends successfully, favorable results require changing one's attitude towards investments in innovations, namely, increasing one's tolerance for risk. Reducing bureaucratic obstacles when grants are allocated can significantly simplify the process of attracting funding for the development of innovations.

4. The state supports the formation of competencies and technologies for developing innovations in the country

The state invests in the education system to provide specialists with advanced specialties and specialists in related areas to achieve a synergistic effect. At the same time, the government supports the activities of scientific research institutes and other institutes of fundamental research. It also finances a program of training and internships for specialists from various industries who work and study in leading foreign companies and universities so that they can develop new competencies and exchange experiences.

Through regulatory policy, the state boosts the development of R&D and competencies in the private sector, creates public and private competency centers, and supports their functioning. The government also actively transfers foreign technologies. Thus, by signing license agreements or creating a joint venture, the Agency for Technological Development assists domestic enterprises in implementing world-class technological solutions to increase the competitiveness of their products (Mazzucato et

al., 2019).

5. The state promotes the development of an entrepreneurial and innovative culture

The state plays a vital role in developing a culture of entrepreneurship and innovation by implementing educational programs, supporting a mentoring system, and creating and assisting development agencies and institutions. Besides, the government is actively engaged in promoting innovative entrepreneurship. However, considering the relatively short history of the market economy in the country, it is necessary to continue the course towards promoting entrepreneurship and innovation (for example, by increasing the number of incubators and the number of events and competitions for venture market participants, such as a startup fair and others). Active PR support and distribution of startup success stories that have yet to be made known to the general public are significant, too. The state has just begun its activities in this direction. So, it is crucial to make more efforts and to pay enough attention to this dimension (Bradley et al., 2021).

3. Innovations in Uzbekistan: A brief historical overview

Uzbekistan has identified the accelerated introduction of modern innovative technologies in all fields as a critical factor in the country's dynamic development. The main objectives are to fulfill national science's potential and ensure access to the global market of modern technologies (including the transfer and commercialization of sci-tech developments). To accomplish these purposes, the government has adopted the "Strategy of Innovative Development" to concentrate the efforts of state bodies and organizations in developing innovative fields in Uzbekistan. It is stated that the strategy should help the country strengthen the quality of human capital and, by 2030, get into the top 50 countries of the world, which the Global Innovation Index rates through innovational measures, environments, and outputs (Abdurakhmanov et al., 2018).

In September 2016, for the first time, the Virtual reception of the President of the Republic of Uzbekistan, which any citizen of the country can contact, was launched. This practice became so popular that almost 2 million citizens contacted the reception in the first two years. In addition, portals for providing public services to citizens (e.g., my.gov.uz) and interdepartmental interaction have been actively developed. Such reforms were aimed at laying the foundations of transparency and accountability mechanisms (Abdugapporovich, 2022). For the first time in the country, a system for announcing startup project competitions has been established, and funding mechanisms have been introduced. The above means supporting products at the initial and final stages when the products are ready to enter the market. In this respect, the first scientific accelerator in Uzbekistan - the C.A.T. Science Accelerator - has been organized to support projects at the initial stage. 35 startup projects have been funded for 33 billion soums (Allayarov & Ravshanova, 2021). In 2018, following the Decree of the President

of the Republic of Uzbekistan, a new system for commercializing scientific developments was created. It aims to ensure the accelerated implementation of national scientific-applied and innovative projects and developments and increase the contribution of science to develop the competitiveness of the country's economy. The Customer-Researcher-Investor portal was launched (about 530 developments have been registered in this portal) to select scientific and innovative developments and attract investors for commercialization. The International Week of Innovative Ideas "InnoWeek" was held three times, 2018-2020, to achieve the abovementioned results.

At the end of 2019, a subordinate organization was launched at the Ministry of Innovative Development of the Republic of Uzbekistan. It is called the Center for Scientific and Technical Information, which actively monitors ongoing scientific and innovative projects. What is more, within the center, a database of electronic reporting documentation on scientific and innovative projects was created and financed from the state budget from 2017 to 2019 (more than 4.5 thousand reports on more than 1.5 thousand projects). Based on the collected reports, an analysis of the effectiveness was carried out, culminating in identifying the results of scientific and technical activities that have the potential for commercialization.

The Uzbek government created the Ministry of Innovative Development of the Republic of Uzbekistan, which has already developed and implemented more than 60 regulations and adopted two essential laws — "On Science and Scientific Activity" and "On Innovation Activity" which serve as a solid foundation for developing research and innovation activities in the country. It is also crucial to emphasize the importance of the Concept of the Development of Science in the Republic of Uzbekistan until 2030, which was developed by the Ministry of Innovative Development and adopted in 2020 (Turgunov, 2021). The departments for developing scientific and innovative activities are created within the structure of regional administration (also known as *khokimiyats*) to promote innovative ecosystems in Uzbekistan's regions. In this regard, the Ministry of Innovative Development and regional administration (*khokimiyats*) hold competitions to finance scientific and innovative projects. The projects that won the competitions were financed in equal shares (50% from the republican budget and 50% from the local budget).

In 2022, in the index rankings of the Global Innovation Index (Dutta et al., 2022) announced by the World Intellectual Property Organization (WIPO) entitled "The future is growth based on innovation," Uzbekistan had improved by four positions compared to 2021 and placed 82nd. As a result, fundamental and consistent reforms carried out in Uzbekistan regarding innovation development helped the state enter the top ten rapidly rising countries (Dutta et al., 2022). Uzbekistan has set the goal of becoming one of the 50 countries rated in the Global Innovation Index by 2030. In general, the dynamics of the past years show the rapid growth of the position of Uzbekistan. One of the essential steps in Uzbekistan's achievement of good indicators in international indices and ratings is adopting the Concept for the Development of

Science until 2030. However, it also should be noted that the amount of funds allocated in Uzbekistan for science and scientific activities is only 0.5 percent of the gross domestic product. What is more, the level of commercialization of scientific research results is also low. It affects the lack of investment and bank loans for scientific institutions and the innovative enterprises they organize.

Almost all reforms in Uzbekistan have started at a top-down level. The President of Uzbekistan is authorized to appoint and remove county governors, ministers, rectors and other high-ranking officials. The increase in the term of office of the President of Uzbekistan from five to seven years occurred on April 30, 2023. Uzbekistan is one of the few countries with no possibility of impeaching the president as defined by laws or the Constitution. The above indicates a highly centralized and authoritarian model of public administration, according to which the government is the initiator of all innovations and the most interested party. Even though this model makes it possible to conduct research in socially important areas of the economy, the projects are only sometimes implemented effectively. The most effective implementation and commercialization of innovations occurs in business.

To coordinate state policy in Uzbekistan, institutions established by presidential or government orders carry out their activities. The study analyzed the activities of all institutions formed since independence in 1992. The established institutions that are involved and responsible for monitoring the implementation of ongoing reforms are presented below in chronological order with the role of the institution:

- The Commission for Monitoring the Implementation of Decisions on Economic Reforms in the Republic of Uzbekistan (Decree of the President of the Republic of Uzbekistan, 1992). It coordinates activities of interdepartmental control bodies on economic reforms, organization of performance reviews, the study of the state of executive discipline, analysis and awareness of the government of Uzbekistan about the progress of economic reforms at specific enterprises, industries and territories of the republic
- The Center for Economic Research and Reform at Presidential Administration (Order of the President of the Republic of Uzbekistan, 1999). It monitors the progress of socio-economic reforms and the assessment of their effectiveness.
- The Institute for Monitoring of Current Legislation is under the President of the Republic of Uzbekistan (Decree of the President of the Republic of Uzbekistan, 2005). It monitors the implementation of law norms at the local level, conducts public opinion surveys on the effectiveness of laws adopted and law enforcement practice, and develops proposals for their improvement.
- The Information and Analytical Department for Integrated Socio-Economic Development of Territories in the Structure of the Cabinet of Ministers (Resolution of the Cabinet of Ministers of the Ruz, 2017). It systematically monitors the dynamics of the major economic indicators and structural and institutional reforms, executes local budgets and improves the monitoring

system and program analysis for the socio-economic development of territories, other territorial programs, and the introduction of effective methods and indicators for assessing the level of socio-economic development.

- The Commission for the Introduction of New Mechanisms exists to study the socio-economic development of territories, sectors of the economy and the social sphere (Decree of the President of the Republic of Uzbekistan, 08.08.2017). It includes coordination and improvement of the efficiency of sectors, analysis of information on the sectors' activities, evaluation of the effectiveness of institutional and practical measures implemented in the sectors, and implementation of systemic control over the implementation of targeted instructions for the integrated socio-economic development of the regions. A unique system was developed to organize sectors' work aimed at the integrated socio-economic development of cities and regions.
- The Center for 'Development Strategy' implements (Decree of the President of the Republic of Uzbekistan, 14.02.2017) systemic public monitoring of the implementation of the Action Strategy and develops recommendations concerning its high-quality and timely implementation. Thus, a media product such as a single electronic platform "reforms.uz" was created.
- The Agency for Legal Support of Reforms and Coordination of Law Enforcement Activities of the Office of the President (Decree of the President of the Republic of Uzbekistan, 2018) systematically monitors the implementation of State programs and develops recommendations for taking additional measures to ensure their high-quality and timely implementation, reporting to the Presidential Administration and the Cabinet of Ministers.
- The nationwide movement 'Yuksalish' (Resolution of the Cabinet of Ministers of the Ruz, 2019) systematically monitors the implementation of legislation and regulations aimed at ensuring the implementation of the goals and objectives of the Republic of Uzbekistan in terms of sustainable development.
- A Parliamentary Commission to monitor the implementation of the national goals and objectives in the sustainable development of the Republic of Uzbekistan for the period up to 2030 (Joint Resolution of the Council of the Legislative Chamber of the Oliy Majlis (Parliament) and the Council of the Senate of the Oliy Majlis of the Ruz, 2020). A consultative and advisory body - the Public Chamber under the President of the Republic of Uzbekistan and the public chambers of the Republic of Karakalpakstan, regions and the city of Tashkent (Decree of the President of the Republic of Uzbekistan, 2020). Development of recommendations for improving public monitoring of implementing reforms and state programs locally and in sectors, and the adoption of additional measures or their qualitative implementation with regular submission of information on the achieved indicators, positive changes and existing problems to the President of the Republic of Uzbekistan,

the Parliament of Uzbekistan (Oliy Majlis) and the Government.

All coordination of state policy in Uzbekistan is carried out under the president or bodies subject to the president. Monitoring and the results of the authorities' activities are presented to the President of Uzbekistan. As an initiative of the president, the state innovation policy is directly coordinated by the president and presidential administration. However, according to the president's resolutions, the prime minister and the head of the presidential administration carry out the process of monitoring and controlling authorities.

Having analyzed the legal documents, the following shortcomings that can be further improved are pointed out:

- There needs to be a clear division of responsibilities between ministries and departments. The relationship between control bodies is not regulated;
- The evaluation of performance indicators is formal, and there is no decision on the results of the evaluation;
- The absence of a single body responsible for monitoring the effectiveness of reform implementation;
- Coordination functions are often duplicated;
- The absence of a single mechanism for assessing the outcomes;
- The absence of an approved and unified methodology for monitoring and evaluating reform implementation;
- There is difficulty getting information on the results of monitoring and coordination. Information is provided through requests to the relevant departments, which is a bureaucratic process.

In order to achieve effective coordination of state and innovative policies, it is necessary to determine a responsible single state body, develop and implement an electronic platform for collecting and presenting data, review duplicate functions, pay attention to positive international practices, standardize approaches towards assessment, and conduct a centralized training.

4. Methodology

It has to be considered that this work creates a complex econometric model that will serve as a statistical tool, but for the analysis of innovations, it takes one more step to try to find some influence on the innovation development process. The data are analyzed *ceteris paribus*. The main statistics will be presented in the form of graphs and tables for ease of interpretation. Comments on the primary data analysis will also be added.

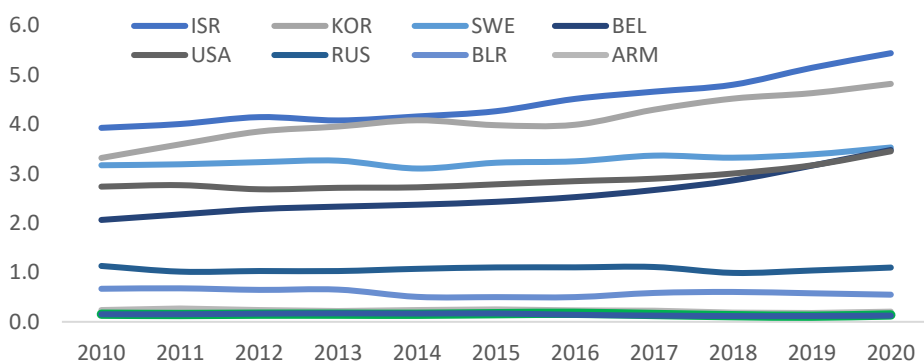
In order to make a regression analysis and obtain an econometric equation, factors (independent variables) to be tested needed to be chosen. A model will be created because there is no exact model for calculating innovation. After looking through much research discussed above, a model using the factors shown in the table below has been

chosen to be made. The selected indicators are based on the five key roles of the state in the development of innovation, described above in the theoretical part. The dependent variable will be the number of innovations produced (creative outputs).

It is essential to distinguish the innovative output from the innovative outcome. Innovative output can be quantified, e.g., the number of registered innovative patents, the number of innovative products in total production or other quantitative metrics that show the technologically innovative production in a country. As for innovative outcome, it is a consequence of innovative output resulting in improved quality of life, reduced costs or a change in the production model resulting in more profitable production and economic growth. Innovative outcomes are more difficult to quantify, but Uzbekistan's technological and economic development indicates it. Since many other factors may influence the outcome, this study utilizes output.

Data description. The study examines government spending on research and development to assess the government's contribution to basic research. According to the National Statistical Center of Uzbekistan, spending on research and development in 2022 and 2021 amounted to 0.33 and 0.2 percent, respectively. According to the OECD, in the CIS countries, R&D does not significantly impact innovation. In the case of small and medium enterprises, innovation can be either "capital equipment or input-embodied innovation" or "design innovation." Although not all firms make innovations, many have the potential to do so. According to their research, companies with highly educated employees who have introduced at least one new product give considerable weight to client satisfaction, research their markets, have good relationships with other companies and do not get subsidies or own patents.

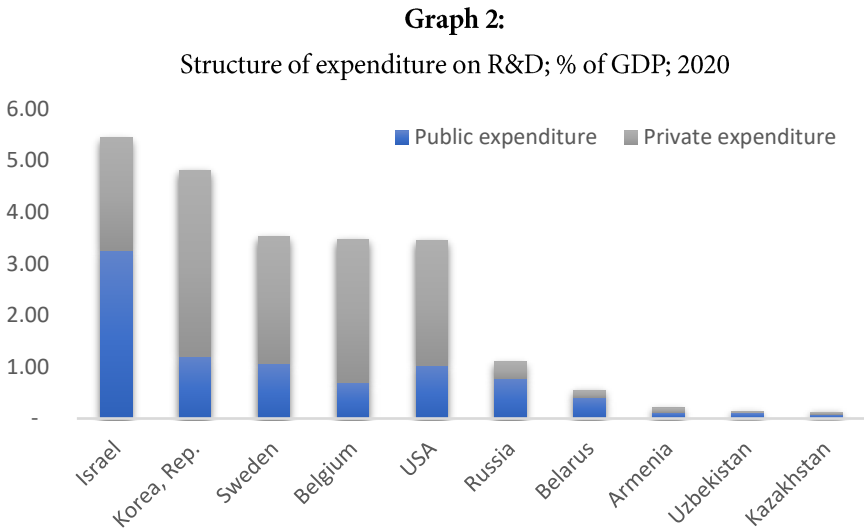
Graph 1:
Expenditure on research and development; % of GDP



Source: Author's own based on data from the World Bank; % of GDP, 2024

It can be noted that despite a significant increase in R&D expenditure, the amount for Uzbekistan is insignificant. Basic research in Uzbekistan is carried out based on research universities. Research is carried out on grants and government orders initiated by the government. In this case, one-way communication works, as research universities have no initiative and involvement.

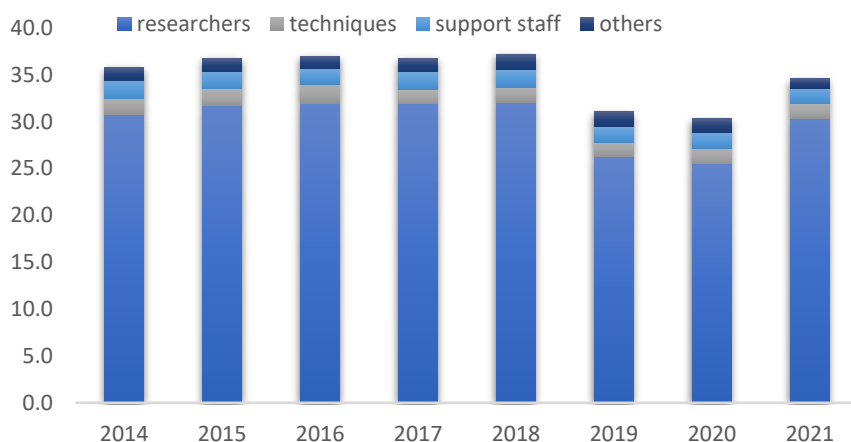
The structure of research and development expenses is shown in the chart below. In Europe and the United States, the majority of private sector spending, in the post-Soviet countries, most government spending. In addition, it is worth noting that a large share of GDP in Europe also falls on the private sector, while in the post-Soviet countries it falls on state-owned companies. The above indicates the inactivity of the private sector and the underdevelopment of the business (industry), the most crucial element of the NIS responsible for the commercialization and implementation of innovations.



Source: Author’s own based on data from the World Bank; % of GDP, 2024

In addition, Graph 3 provides data on the number of researchers in Uzbekistan. During the period under review, there was no significant change in the number of researchers, technical specialists, and other workers employed in the technology sector. In 2019, there was a decrease in the number of researchers, which can be explained by a change in the calculation methodology, but the variation is not significant and will not strongly affect the regression analysis.

Graph 3:
Number of researchers; a thousand

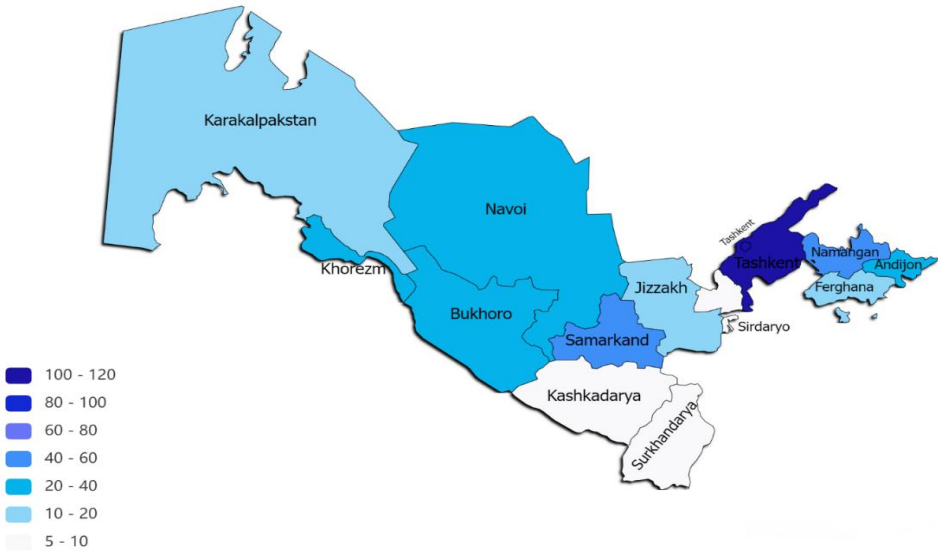


Source: Author's own based on data from the Statistics Agency under the President of the Republic of Uzbekistan, 2024

Graph 4 shows a map with data on the number of infrastructure innovation facilities (Research centers, innovation clusters, special economic zones, innovation development agencies, and others) by region of Uzbekistan for 2020. Most infrastructure facilities are concentrated in the capital, Tashkent. We can make a preliminary conclusion that centralized power contributes to the concentration of infrastructure facilities closer to the administrative apparatus to reduce the costs of coordination.

Graph 4:

Number of innovative infrastructure facilities by region



Source: Author’s own based on data from the Statistics Agency under the President of the Republic of Uzbekistan, 2024

The rest of the data will be described based on the regression analysis’s results. The regression analysis used data from 2009 to 2021, that is, 13 years related to Uzbekistan.

The indicators describing the five key roles of the State in the development of innovation are collected into four factors and are described in the table below.

Table 1:
Measurement of factors

Nº	Factor	Description
Y	Creative outputs (dependent variable)	Number of creative goods and services, intangible assets and other (World bank data)
X2	Infrastructure	Research centers, innovation clusters, special economic zones, innovation development agencies and institutions and other infrastructure facilities. (Knoema/ World Bank)
X3	Human capital	Number of researchers with higher education (Internal Data of Ministry)
X4	Business sophistication	Number of Collaboration projects (University-industry, PPP, business investment in innovation), high-tech import. (Knoema/ World Bank)
X5	Institutions	Regulatory environment (number of procedures to start business), tax incentives, amendments to laws. (Internal data/ local statistics)

Source: Author’s own, 2024

5. Research results

As a result of the primary regression analysis from various indicators, only four independent variables are statistically significant, and those are X2 – Infrastructure, X4 - Business sophistication and X5- Institutions. Thus, the subsequent regression was made for only the statistically significant independent variables using the Log-Log regression. The model obtained with significant independent variables was used to explain the variation in the dependent variable. The coefficients are statistically significant in the used model, and the standard errors are low. The adjusted R-squared of the model is 73%, which is a significantly high result. No problems of autocorrelation and multicollinearity were observed. This particular model was deemed as the most appropriate model from those attempted. Data on financial expenditures on R&D are not considered in the model since inflation and the ratio to GDP are taken into account, and this indicator did not change significantly during the period under review.

Table 2:

Regression Statistics

<i>Regression Statistics</i>	
Multiple R	0.901237612
R Square	0.738312131
Adjusted R Square	0.737870077
Standard Error	5.923134364
Observations	13

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	38.6318587	10.93570615	4.447070726	0.000125493	26.23108011	71.03263728	26.23108011	71.03263728
X2 (Infrastructure)	0.377849644	0.209880979	11.78692823	8.76033E-10	1.487725885	2.347569276	1.487725885	2.347569276
X3 (Human capital)	-0.031613507	0.002913004	10.85254462	1.53445E-11	-0.037580525	-0.025646488	-0.036568908	-0.026658105
X4 (Business sophistic	0.565996441	0.314389305	17.65612204	1.31225E-09	2.22852547	3.516520065	2.22852547	3.516520065
X5 (Institutions)	0.292896441	0.162692734	9.136833611	6.79072E-10	1.153235482	1.819757399	1.153235482	1.819757399

Source: Author's own, 2024

The model is described as follows:

$$Y(\text{Creative output}) = 0.377 \cdot X2 + 0.565 \cdot X4 - 0.292 \cdot X5 + 38.6$$

The correlation between y and $\hat{y}$ is 0.9 (when squared, it gives 0.73). The standard error of regression here refers to the estimated standard deviation of the error term u . This type of data is more complicated than simple time series or cross-sectional as it combines them. It requires careful handling and manipulation. Panel data estimations are assumed to be more accurate as the data varies across two dimensions, and the data observed becomes more realistic and accurate.

The strongest influence on Creative output is X4—business sophistication. This means that mechanisms of support for business, creating conditions for innovations, are the most effective way to create innovations in Uzbekistan. The more government deals with business, the more creative output the country creates.

According to the results of the regression analysis, a strong influence on creative output affects business sophistication. The above means that the more business and research institutions are involved in innovative projects, the more innovative goods are produced in Uzbekistan. In addition, the business environment also affects creative output. More and better infrastructure and fewer bureaucratic procedures for business will be better for producing innovative goods in Uzbekistan. For non-essential indicators, it should be noted that government spending on research and development and the number of researchers have a minimal impact on the production of innovative goods in Uzbekistan.

6. Discussion

Despite the good results in the authoritative international ranking of the GII-2022, the peculiarity of Uzbekistan should be noted based on the analysis. Uzbekistan has a strong centralized structure, with a high share of state participation in financing and initiating innovations in the country. The State also indicates the achievement of high places in various international ratings as a goal and, therefore, seeks to improve the indicators used in calculating ratings. According to the study, business sophistication has the most significant impact on Innovative Output. In support of the study's results, business sophistication positively correlates to and substantially explains (57%) innovation outputs. It is the only statistically significant pillar and explains more than half of innovative outputs. The above is consistent with previous findings that indicate the importance of developing cooperation with the private sector in innovation development. Cooperation is not a new subject; the importance of cooperation and the private sector to the innovation process has been thoroughly studied within different economic and management theories, such as systems of innovation, the triple helix and, more recently, business and innovation ecosystems (Brogaard, 2021). In line with this, the level of interaction with different parties is the key determinant to boosting the innovation performance of the developing country. An innovation perspective study by Giones states that university-industry collaboration can be enhanced by training that focuses on attitude change of firm owners, innovation vouchers, and grants by a university (Giones, 2019).

The peculiarity of Uzbekistan and Central Asian countries in innovation is the economy's dependence on public expenditures. While in European countries, the share of R&D expenditure is allocated to innovative private companies, in Central Asian countries, the majority of R&D expenditure is allocated to public expenditures (Jurak,

2020). Despite the reduction in funding for innovative companies in Slovakia, overall R&D funding is increasing due to EU Framework programs and private companies. For Estonia, there is no strong connection between spending and innovative development. However, for most Central European countries, spending on development and research plays a vital role in economic development and added value (Pisár et al., 2021). The regional benchmark for Uzbekistan is Kazakhstan, which went through the stages of reform and the transition to innovative development earlier. Tajikistan and Kyrgyzstan are more agricultural and resource-based economies facing the innovation sector's development path. Expenditure on R&D and support for innovative companies are not very pronounced in these countries.

Key factors should be identified and prioritized, taking into account country characteristics. In different countries, depending on technological development, the role of the State and public policy are the most critical variables on which the innovative output depends. Knowledge accumulation, stimulation of the private sector and conditions for innovative companies are expected to occur in technologically developing countries. On the contrary, in technologically advanced countries, there is knowledge absorption, regulation of the private sector for the development of socially essential technologies, and the protection of intellectual rights. The current study strengthened the findings of the previous research that indicate the need to consider technological development and the country's peculiarities in implementing state innovation policy.

7. Conclusion

A study of innovation policy in Uzbekistan indicates that improvement reforms have begun relatively recently. The experience of Uzbekistan can be helpful for countries at the initial stage of innovation policy reform. Despite this, the significant contribution of the State to the development of strategic documents, as well as an attempt to monitor and evaluate the activities of public authorities, can be noted. However, performance evaluation is almost always done by the president or the president's office, which is common in countries with a highly centralized administration. The coordination system in Uzbekistan is ineffective since there is no single independent body, and functions are duplicated. At the same time, a significant impact of communication between government, business and research institutions can be traced. In Uzbekistan, businesses and institutions should be more involved in reforming innovation policy. Communication should be more comprehensive and not be imposed exclusively by the State. However, the results of the measures applied by the State indicate a high potential and opportunities for the innovative development of Uzbekistan. In technologically developing countries with a centralized government structure, creating conditions for technology business should be one of the most critical areas of public policy.

Based on the study's results, the less technologically advanced countries could work on knowledge absorption, creating infrastructure and favorable conditions for doing business. Knowledge absorption refers to an organizational capability to integrate, transfer and utilize new knowledge from external sources. State regulation of innovative companies is irrelevant at this stage since technology companies are unstable and do not know how to transform knowledge into innovations. They often improve existing technology to a slight degree and work according to existing models of developed companies. Government policy should be aimed at cooperation between business and research institutions, not minimizing the role of other actors but helping their development.

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