ADVANCING ECONOMIC PROSPERITY THROUGH INNOVATION: THE AZERBAIJANI MODEL OF INNOVATION-DRIVEN ECONOMIC GROWTH

Daxil olub: 26 avqust 2025-ci il
Qəbul olunub: 1 dekabr 2025-ci il

Received:26 August 2025
Accepted: 1 December 2025

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DOI: https://doi.org/10.30546/UNECSR.2025.04.3012

Abstract

This study proposes a novel economic development model for Azerbaijan, leveraging the "Quintuple Helix" framework to drive innovation-based growth and ensure long-term sustainability. As Azerbaijan transitions from a resource-dependent economy to one driven by innovation, competitiveness, and diversification, this research provides an analysis of both domestic innovation activities and international best practices to formulate a comprehensive model.

The proposed model emphasizes the integrated collaboration of five key stakeholders: government, private sector, research and educational institutions, civil society, and ecological sustainability. Such collaboration is essential for the successful implementation of innovation-led economic transformation. Strategic priorities identified within the model include renewable energy, development of the startup ecosystem, growth of small and medium-sized enterprises (SMEs), and expansion of the digital economy.

This research underscores the critical role of coordinated policy measures and regulatory reforms in fostering a robust innovation ecosystem. The findings provide valuable insights for policymakers, business leaders, and academic institutions, offering a structured approach to enhancing Azerbaijan's competitiveness and sustainability in a rapidly evolving global economy.

The study also calls for future research that incorporates empirical case studies and quantitative evaluations to assess the practical impact of the proposed model.

Keywords: *innovation, technological innovation, research and development, innovation policy, green technology, start up, macroeconomic policy coordination, development.*

JEL Classification: *O31, O32, O38, Q55, L26, E61*

İNNOVASİYA VASİTƏSİ İLƏ İQTİSADİ RİFAHIN İNKİŞAFI: İNNOVASİYALI İQTİSADİ ARTIMIN AZƏRBAYCAN MODELİ

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Xülasə

Bu tədqiqat Azərbaycanda innovasiyaya əsaslanan iqtisadi artımı stimullaşdırmaq və uzunmüddətli dayanıqlılığı təmin etmək məqsədilə "Beşli Spiral" yanaşmasına söykənən yeni iqtisadi inkişaf modelini təklif edir. Azərbaycanın resurslara əsaslanan iqtisadiyyatdan innovasiyalı iqtisadiyyata və iqtisadiyyatın diversifikasiya olunmasına keçid mərhələsində olduğu bir vaxtda, bu araşdırma həm ölkədaxili innovasiya fəaliyyətlərini, həm də beynəlxalq təcrübələri təhlil edərək hərtərəfli yeni model formalaşdırır.

Təklif olunan model hökumət, özəl sektor, elm (tədqiqat və təhsil), vətəndaş cəmiyyəti və ekoloji dayanıqlılıqdan ibarət beş əsas elementin inteqrasiyalı əməkdaşlığını vurğulayır. Bu əməkdaşlıq innovasiyaya əsaslanan iqtisadi transformasiyanın uğurlu icrası üçün həlledici əhəmiyyət daşıyır. Model çərçivəsində müəyyən edilən strateji prioritetlərə bərpa olunan enerji, startap ekosisteminin inkişafı, kiçik və orta sahibkarlığın böyüməsi və rəqəmsal iqtisadiyyatın genişlənməsi daxildir.

Araşdırma daxilində güclü innovasiya ekosisteminin formalaşmasında koordinasiyalı siyasət tədbirlərinin və normativ-hüquqi islahatların mühüm rol oynaması vurğulanır. Nəticədə siyasətçilər, biznes liderləri və akademik müəssisələr üçün dəyərli tövsiyələr təqdim edilir, Azərbaycanın sürətlə dəyişən qlobal iqtisadiyyatda rəqabət qabiliyyətini və dayanıqlılığını artırmaq üçün strukturlaşdırılmış yanaşma təklif edilir.

Açar sözlər: *innovasiya, texnoloji innovasiya, elmi tədqiqat, innovasiya siyasəti, yaşıl texnologiya, startap, makroiqtisadi siyasətin koordinasiyası, inkişaf.*

РАЗВИТИЕ ЭКОНОМИЧЕСКОГО БЛАГОСОСТОЯНИЯ ПОСРЕДСТВОМ ИННОВАЦИЙ: АЗЕРБАЙДЖАНСКАЯ МОДЕЛЬ ИННОВАЦИОННОГО ЭКОНОМИЧЕСКОГО РОСТА

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Резюме

Данное исследование предлагает новую модель экономического развития Азербайджана, основанную на концепции «Пятикратной спирали», с целью стимулирования инновационного экономического роста и обеспечения долго-

срочной устойчивости. В период перехода Азербайджана от ресурсозависимой экономики к инновационной и диверсифицированной экономике данное исследование анализирует как внутреннюю инновационную деятельность, так и международный опыт, формируя комплексную модель.

Предлагаемая модель акцентирует интегрированное сотрудничество пяти ключевых элементов: государства, частного сектора, науки (исследовательских и образовательных институтов), гражданского общества и экологической устойчивости. Такое сотрудничество имеет решающее значение для успешной реализации инновационно-ориентированной экономической трансформации. В рамках модели стратегическими приоритетами определены возобновляемая энергетика, развитие стартап-экосистемы, рост малого и среднего предпринимательства, а также расширение цифровой экономики.

В исследовании подчеркивается важная роль координированных мер государственной политики и нормативно-правовых реформ в формировании сильной инновационной экосистемы. В результате для политиков, бизнес-лидеров и академических институтов представлены ценные рекомендации, предлагающие структурированный подход к повышению конкурентоспособности и устойчивости Азербайджана в условиях стремительно меняющейся глобальной экономики.

Ключевые слова: *инновация, технологическая инновация, научное исследование, инновационная политика, зеленые технологии, стартап, координация макроэкономической политики, развитие.*

INTRODUCTION

In the contemporary era, innovation has become a fundamental driver of economic growth and long-term prosperity. Countries that effectively integrate innovation into their economic policies gain a significant competitive advantage in the global market. The rapid advancement of digital technologies, artificial intelligence, and automation has transformed traditional economic structures, making knowledge and technological capabilities essential components of sustainable development. In this context, fostering an innovation-driven economy is no longer a choice but a necessity for nations seeking to achieve long-term economic resilience, higher productivity, and diversification of income sources.

For Azerbaijan, a country with a historically resource-dependent economy, transitioning towards an innovation-led growth model is a strategic imperative. The nation has experienced significant economic expansion over the past few decades,

primarily driven by oil and gas revenues. However, heavy reliance on natural resources presents inherent risks, including price volatility in global energy markets and the eventual depletion of fossil fuel reserves. To mitigate these challenges and secure sustainable economic progress, Azerbaijan must embrace a well-structured, innovation-driven growth strategy that aligns with its national priorities and long-term vision.

An effective innovation-based economic model for Azerbaijan should be tailored to its specific economic, social, and institutional characteristics. This model should prioritise the development of a knowledge-based economy by fostering a strong research and development (R&D) ecosystem, investing in human capital, supporting entrepreneurship, and enhancing technological capabilities across various sectors. Additionally, strengthening linkages between academia, industry, and government institutions is crucial for fostering an environment conducive to innovation and commercialisation of research.

This study aims to explore the concept of innovation-driven economic growth in both theoretical and practical contexts, assessing its potential impact on the Azerbaijani economy. By examining global best practices and analysing Azerbaijan's unique economic conditions, the research seeks to identify optimal strategies for fostering innovation-led development. The findings of this study will provide valuable insights into how Azerbaijan can effectively leverage innovation to enhance economic resilience, improve competitiveness, and achieve long-term prosperity in the face of global economic transformations.

LITERATURE REVIEW

The concept of innovation-driven economic growth has been extensively studied as one of the fundamental research areas in modern economics. Innovation is widely recognised as a key determinant of long-term economic growth, driving productivity enhancements, industrial transformation, and technological progress. Over the past century, numerous economic theories have explored the role of innovation in shaping national economies, emphasising the mechanisms through which technological advancements contribute to sustainable development. The experiences of developed economies have provided empirical evidence on the effectiveness of innovation-led policies in fostering economic resilience, competitiveness, and structural transformation.

One of the foundational theories explaining the intricate relationship between innovation and economic growth is Joseph Schumpeter's concept of "creative

destruction" (Schumpeter, 1942) [25]. Schumpeter argues that innovation serves as a disruptive force that continuously replaces obsolete production processes with more efficient and advanced technologies. This process not only fuels economic dynamism but also fosters entrepreneurial activity, leading to the emergence of new industries and business models. Schumpeter's insights laid the groundwork for numerous studies exploring how technology-driven change stimulates economic progress.

Building upon Schumpeter's ideas, economists such as Robert Solow (1956) [26], Paul Romer (1990) [23], and Philippe Aghion & Peter Howitt (1992) [15] have further examined the role of innovation in economic development. Solow's neoclassical growth model posits that technological progress is an exogenous factor influencing long-term economic growth. In contrast, Romer's endogenous growth theory (1994) [24] shifts the focus towards internal drivers of innovation, arguing that knowledge accumulation and investment in human capital are critical to sustained economic expansion. Aghion and Howitt (1992) expand on these ideas by integrating Schumpeterian creative destruction into growth theory, demonstrating how competition and technological advancements lead to higher productivity levels.

Empirical research based on the experiences of high-income economies underscores that innovation is a fundamental prerequisite for transitioning from a resource-based to a knowledge-driven economic model. Michael Porter (1990) [13] approaches innovative economic development from the perspective of competitive advantage, emphasising the necessity of increasing R&D expenditures and fostering a dynamic business environment for sustained national growth. Porter's diamond model illustrates how innovation-intensive economies thrive by leveraging strong institutional frameworks, skilled labour, and strategic industry-government collaboration.

International organisations such as the OECD, the World Bank, and the World Economic Forum have conducted extensive studies on innovation policies, confirming that digital transformation, investment in scientific research, and the development of startup ecosystems play a crucial role in economic prosperity. Reports from these institutions emphasise that economies investing in cutting-edge technologies, artificial intelligence, and sustainable energy solutions experience higher productivity gains and long-term stability. Additionally, the Global Innovation Index serves as a key benchmark for assessing national innovation capabilities, highlighting the role of innovation policies in shaping economic trajectories.

Academic research has also explored Azerbaijan's innovation landscape, identifying key challenges and opportunities. Studies by A. Huseynova (2020) [8] and N. Abbasov (2019, 2022) [1, 2] analyse various aspects of innovation-driven economic growth in Azerbaijan, focusing on policy implementation, institutional frameworks, and the role of foreign direct investment (FDI) in technological advancement. Additionally, reports from the Centre for Analysis of Economic Reforms and Communication emphasize the significance of venture capital development, startup ecosystem support, and digitalization in fostering an innovation-led economy. Despite these efforts, Azerbaijan faces several obstacles, including relatively low R&D expenditure as a percentage of GDP, limited university-industry collaboration, and the need for more structured incentive mechanisms to promote private-sector innovation.

Governments play a crucial role in shaping national innovation ecosystems by providing financial support, establishing regulatory frameworks, and fostering collaboration between key stakeholders. According to Abbasov (2023) [3], the state is not merely responsible for setting legal and institutional conditions but also directly engages in funding and implementing incentive policies that stimulate research, technological development, and entrepreneurship. Government intervention is particularly essential in emerging economies, where private-sector investment in innovation remains limited due to high risks and uncertain returns.

International studies highlight various models of state involvement in innovation-driven economic growth. The OECD (2024) [14] discusses how governments worldwide balance financial support for innovation while addressing broader policy objectives such as productivity enhancement, environmental sustainability, and digital inclusion. Many governments adopt a mission-orientated innovation policy, directing investments toward strategic sectors such as renewable energy, biotechnology, and artificial intelligence. Countries with well-established national innovation strategies—such as South Korea, Israel, and Finland—demonstrate that sustained public investment in R&D and strong institutional coordination significantly contribute to long-term economic competitiveness.

The development of innovation ecosystems, encompassing infrastructure, institutions, and networks that support innovative activities, has become a critical area of research in recent years. Autio & Thomas (2014) [4] argue that effective innovation ecosystems rely on close collaboration between government agencies, private enterprises, universities, and research institutions. This triple-helix model [7] suggests that a well-functioning innovation ecosystem is not limited to technology

hubs or startup incubators but requires an integrated approach that considers economic, social, and institutional dimensions.

METHODOLOGY

The primary methodology in this study is based on a systematic and integrative analysis of the innovation-driven economic growth model. This systematic approach examines the interrelationships between various elements of the innovation ecosystem, ensuring that the model reflects the complex and dynamic nature of the innovation process. The analysis emphasizes the importance of collaboration between government, academia, industry, civil society, and environmental factors. By examining these elements within Azerbaijan's context, the study aims to formulate a model that accelerates innovation-led economic development while addressing national challenges.

The innovation model presented here is constructed with a focus on socio-economic development through the promotion of technological advancement, entrepreneurship, and the creation of a knowledge-based economy. This approach is grounded in the understanding that successful economic growth is increasingly dependent on the ability of countries to adapt to technological advancements and foster innovation at all levels of society.

RESULTS

To conduct a comparative analysis of innovation activities in Azerbaijan, the key input and output components are examined in relation to other countries. A comparison is made between Azerbaijan and three countries with similar populations, as well as three Baltic countries. The relevant indicators for 2023 are shown in Table 1.

Table 1. Comparison of key indicators characterizing innovation activities in Azerbaijan and other 7 countries for 2023

Indicators	Azerbaijan	Georgia	Belarus	Austria	Israel	Latvia	Lithuania	Estonia
Some indicators of innovation inputs								
Number of researchers per million inhabitants (full-time equivalent).	1741.1	1623.7	1417.7	6163	5557	2403.6	3940.7	4037.4
Expenditure on scientific research as a share of GDP, in percentage.	0.2	0.3	0.5	3.2	5.6	0.7	1.1	1.8

Expenditure on education as a share of GDP, in percentage.	3.5	3.6	4.7	5.2	6.1	4.4	4	5.3
Import of ICT services as a share of total trade, in percentage.	0.4	1	1	3.4	2.2	1.5	1.3	10
Patent applications (residents and abroad).	248	112	430	10866	15410	236	449	282
By residents.	235	96	377	4134	1435	167	195	96
Abroad.	13	16	53	6732	13975	69	254	186
Ranking position of patent applications.	72	81	65	19	15	75	61	70
International applications for Patent Cooperation Treaty (PCT) agreements.	10	6	16	1547	1906	30	42	32
Some indicators of innovation outputs.								
Patent Grants.	108	122	302	1151	5358	71	93	9
Active patents.	250	892	1490	143690	38145	11282	12990	11752
Patents by origin / billion PPP$ GDP.	0.9	1.4	1.8	7.8	3.6	1.9	1.3	1.7
Scientific and technical articles as a share of GDP in billion PPP dollars.	4.1	11.6	5.8	29.5	29.5	18	23.7	36.3
Cited documents, H-index.	5.9	10.8	10.2	44.4	46.7	9.8	13.6	18.5
High-tech production, in percentage.	12.3	10.4	29.5	45.7	38	18	24.5	29.9
High-tech exports as a share of total trade, in percentage.	0.1	1	1.8	7.9	12.3	7.7	6.1	9.7
Export of ICT services as a share of total trade, in percentage.	0.5	2.3	6.8	3.6	19.2	4.5	2.9	7.2

Source: Global Innovation Index (GII) Report 2023 [29], WIPI, 2023 [30].

In 2023, the number of full-time equivalent (FTE) scientific researchers per million population in Azerbaijan was 1,741.1. In comparison, this figure stood at 6,163 in Austria, 5,557 in Israel, 4,037.4 in Estonia, 2,403.6 in Latvia, 3,940.7 in Lithuania, 1,623.7 in Georgia, and 1,417.7 in Belarus. These statistics indicate that the number of scientific researchers in developed countries is significantly higher than in Azerbaijan. For instance, in Austria, it is 3.5 times higher, and in Israel, it is 3.2 times higher.

The share of research and development (R&D) expenditures in GDP further underscores this disparity. In Azerbaijan, R&D expenditures constitute only 0.2% of

GDP, whereas in Austria, this share is 3.2%; in Israel, it reaches 5.6%; in Estonia, 1.8%; and in Lithuania, 1.1%. Among the selected countries, Azerbaijan exhibits the lowest R&D expenditure relative to GDP. Similarly, education expenditures as a percentage of GDP highlight Azerbaijan's comparatively lower investment in human capital. While Azerbaijan allocates 3.5% of its GDP to education, this proportion stands at 6.1% in Israel, 5.3% in Estonia, 5.2% in Austria, and 4.7% in Belarus, positioning Azerbaijan at the lowest rank among these countries.

With regard to the import of information and communication technology (ICT) services as a proportion of total trade, Azerbaijan again demonstrates the lowest figures. Specifically, ICT service imports in Azerbaijan account for 0.4% of total trade, whereas in Austria, this figure is 3.4%; in Israel, 2.2%; in Estonia, 10%; in Georgia and Belarus, 1%; in Latvia, 1.5%; and in Lithuania, 1.3%. These statistics suggest that Azerbaijan relies less on imported ICT services compared to the other countries under review.

In the global ranking of patent applications, Azerbaijan holds the 72nd position with 248 applications, ranking higher than Georgia (112 applications) and Latvia (236 applications) but falling behind the other countries analysed.

Beyond these statistical indicators, it is important to consider Azerbaijan's overall performance in innovation. According to the Global Innovation Index (GII) 2023 report, Azerbaijan's innovation input indicators are considerably lower than those of the other selected countries. Furthermore, data from the State Statistical Committee of Azerbaijan (SSC) reveal that in 2023, investments in fixed capital within the industrial sector amounted to 8.4 billion manat, representing 26.2% of total investments (Investments, 2023). The trends in fixed capital investments in industry and expenditures on technological innovations from 2010 to 2023, along with their share in total investments, are presented in Table 2.

Table 2. Dynamics of expenditures on technological innovations in Azerbaijan from 2010 to 2023.

Years.	Investments directed to fixed capital in industry, thousand AZN. (1USD=1.7AZN or 1.7 manat)	Expenditures on technological innovations, thousand AZN.	Share of expenditures on technological innovations in investment, in percentage.
2010	4276000	8139	0.19
2015	8499900	35179.1	0.41
2020	9065300	35919.8	0.39
2021	7507300	5848.3	0.078

2022	7172100	22540.4	0.314
2023	8405700	11666.7	0.138

Source: Compiled by the author according to the database of SSC [10, 11].

Compared to 2010, investments directed toward fixed capital in the industrial sector increased by 1.96 times in 2023, reaching 8,405.7 million manats. However, the share of expenditures on technological innovations within total investments exhibited a declining trend, constituting only 0.14% in 2023, compared to 0.19% in 2010 and 0.5% in 2019. Notably, in absolute terms, expenditures on technological innovations decreased to 11.66 million manats in 2023, underscoring the persistently low levels of investment in this domain.

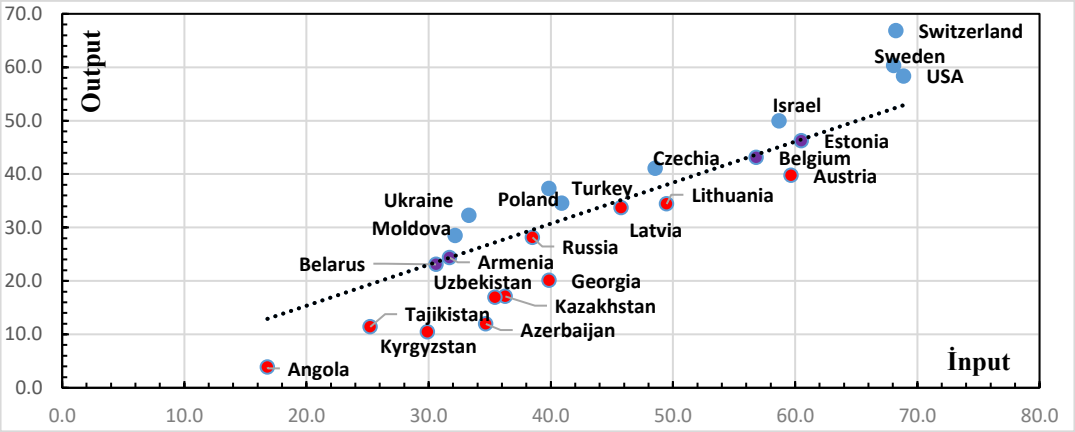
To assess the effectiveness of innovation efforts, it is essential to examine key innovation output indicators. So, in 2023, the number of patents per unit of GDP (in purchasing power parity, PPP dollars) by origin was 0.9 in Azerbaijan, 1.8 in Belarus, 1.4 in Georgia, 7.8 in Austria, 3.6 in Israel, 1.9 in Latvia, 1.3 in Lithuania, and 1.7 in Estonia. The total number of active patents was recorded as follows: 250 in Azerbaijan, 892 in Georgia, 1,490 in Belarus, 143,690 in Austria, 38,145 in Israel, 11,282 in Latvia, 12,990 in Lithuania, and 11,752 in Estonia (GII 2023).

In terms of scientific and technical article output per billion PPP dollars of GDP, Azerbaijan reported 4.1 articles, significantly lower than the figures observed in other countries: 11.6 in Georgia, 5.8 in Belarus, 29.5 in Austria, 29.5 in Israel, 18 in Latvia, 23.7 in Lithuania, and 36.3 in Estonia.

The share of high-tech production in total manufacturing serves as another critical indicator of innovation performance. In 2023, this share stood at 12.3% in Azerbaijan, which was higher than Georgia's 10.4% but considerably lower than Belarus (29.5%), Austria (45.7%), Israel (38%), Latvia (18%), Lithuania (24%), and Estonia (29.9%). For further context, high-tech manufacturing accounted for a significantly larger proportion in G7 economies, including 42.4% in the U.S., 54.6% in Japan, 52.9% in Germany, 42.9% in the U.K., 34.7% in Canada, 48.8% in France, and 38.3% in Italy.

The performance of Azerbaijan in high-tech exports is also comparatively weaker. The share of high-tech exports in total trade was a mere 0.1% in Azerbaijan, whereas this figure was 1% in Georgia, 1.8% in Belarus, 7.9% in Austria, 12.3% in Israel, 7.7% in Latvia, 6.1% in Lithuania, and 9.7% in Estonia.

Based on the analysis of these innovation output indicators, it can be concluded that Azerbaijan's performance remains considerably below that of developed countries. In the following section, the efficiency of innovation outcomes relative to innovation inputs in 2023 will be analysed through a comparative assessment of various countries, as illustrated in Graph 1.



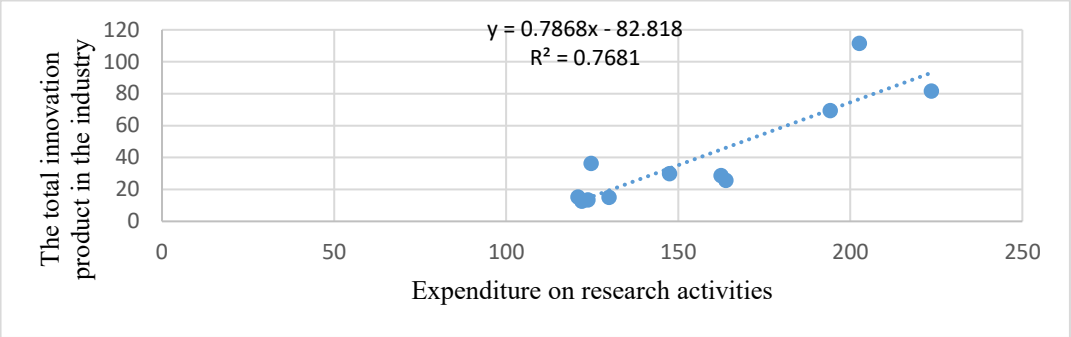
Graph 1. Comparison of Innovation Activity Outcomes in Selected Countries (2023)
Source: Prepared by the author based on statistical indicators from the 2023 GII report.

As illustrated in the graph, several post-socialist countries demonstrated efficient innovation outcomes in 2023 relative to their innovation inputs. Notable examples include the Czech Republic, Poland, Moldova, and Ukraine, which successfully converted their investments in innovation into tangible outputs. However, certain post-Soviet nations recorded lower-than-expected results despite their innovation expenditures. These include Tajikistan, Kyrgyzstan, Uzbekistan, Russia, Latvia, Lithuania, Georgia, and Azerbaijan. Meanwhile, some countries, such as Belarus, Belgium, and Estonia, achieved a balanced outcome, with innovation outputs aligning with their respective inputs.

Although certain countries exhibited lower-than-anticipated returns on innovation investments in 2023, their overall level of innovation activity remains significantly higher than that of Azerbaijan. For instance, Latvia, Lithuania, and Austria continue to demonstrate considerably stronger innovation performance. The graph clearly highlights that Azerbaijan has generated fewer innovative products than expected given its level of investment in innovation. A key factor contributing to this inefficiency is the absence of a favourable competitive environment, coupled with insufficient coordination and oversight mechanisms.

Furthermore, some economies have excelled in translating innovation inputs into high levels of innovation output with remarkable efficiency. Among high-income countries, Switzerland (1st), Sweden (2nd), the United States (3rd), the United Kingdom (4th), and Singapore (5th) stand out as leading performers, significantly surpassing other high-income nations in terms of innovation output relative to input.

It is also important to note that according to the statistical data from 2013 to 2023, there is a strong correlation (+0.87) between the total innovation product in the industry and the expenses incurred for scientific research (see graph. 2), with the condition of $p<0.05$ being satisfied.



Graph 2. Correlation between the total innovation production in the industry and expenditure on research activities
Source: Compiled by the author.

Considering the analyses mentioned above, it should be noted that, the implementation of the Azerbaijani model can contribute to the improvement of innovation activities and the acceleration of economic development in the country.

Another key aspect of the methodology involves the analysis of strategic policy documents and legal frameworks that support innovation in Azerbaijan. These documents provide insights into the government's approach to fostering innovation-driven growth and its alignment with global best practices. Key documents include:

- "Azerbaijan 2030: National Priorities for Socio-Economic Development" (Presidential Decree No. 2469, 2021) [18], which outlines the country's long-term development strategies focused on a knowledge-based economy.
- The Strategy for Socio-Economic Development of the Republic of Azerbaijan for 2022-2026 [20], which emphasizes the role of innovation in economic diversification and sustainable development.
- The Decree of the President of the Republic of Azerbaijan on Approving Strategic Roadmaps for Key Sectors of the Economy (Presidential Decree No.

1138, 2016) [19]. This document provides a legal framework aimed at accelerating technological development and innovations in Azerbaijan.

- "Decree of the President of the Republic of Azerbaijan on Improving Management in the Field of Digital Transformation" (Presidential Decree No. 1325, 2021) [16] and "Decree on Some Measures to Improve Management in Digitalisation, Innovation, High Technologies, and Communications in the Republic of Azerbaijan" (Presidential Decree No. 1464, 2021) [17]. These decrees shape the state's policy on digital transformation and the application of new technologies.
- Digital Development Concept of the Republic of Azerbaijan (Concept of Digital Development, 2025) [5]. This concept aims to accelerate the country's digital transformation process and ensure economic and social development through the application of modern technologies.

By analysing these documents, the study identifies the government's commitment to creating a supportive environment for innovation, including investments in digital transformation, R&D infrastructure, and the development of the entrepreneurial ecosystem.

Innovation Ecosystem Study

To analyse the development of the innovation ecosystem, various infrastructure and support measures promoted by the government are considered. The different centres and parks created in Azerbaijan for the development of innovation and technologies play a key role in this part. The activities related to technoparks, incubation centres, and the support of startups are evaluated, including the following:

1. High Technology Parks: The Azerbaijan National Academy of Sciences' High Technology Park and the Mingachevir High Technology Park were created to accelerate the development of technology sectors and support the development of the non-oil sector in Azerbaijan (ANAS, 2016; Presidential Decrees No. 481 & 736) [21, 22].
2. Incubation Centres and Startup Support: The "INNOLAND Incubation and Acceleration Centre" (INNOLAND, 2025) [9] is an important institution that supports the development of startups. It carries out activities related to the application of modern technologies and the financing of innovation projects.
3. Startup Certificates and Venture Capital Fund: Government initiatives such as the "Startup Certificate" (Startup Certificate, 2021) [27] and the "Caucasus

Ventures" Venture Capital Fund (VCF, 2022) [28] aim to support startups and innovation projects. These are also key subjects of this research.

Furthermore, it is crucial to examine the following areas specifically, the development of the digital economy in Azerbaijan and the application of new technologies have a fundamental impact on innovation-driven economic growth. The most important measures in this field include:

- E-Government and Digital Services: The "ASAN Service" (2012) and the "myGov" platform (2019) have accelerated the process of digitising govern-ment services.
- Artificial Intelligence and Blockchain Technologies: The Azerbaijani government has taken various steps towards the implementation of artificial intelligence and blockchain technologies. The application of digital technologies and strategic development in this area are also focal points.

Public-Private Partnerships (PPP) and International Collaborations

A critical component of Azerbaijan's innovation-driven economic growth is the role of public-private partnerships (PPP) [12]. In this context, the "Public-Private Partnership Law of the Republic of Azerbaijan" (Law No, 691-VIQ, 2022) and other legislative initiatives are significant.

Furthermore, the country's collaborations with various international institutions, universities, and technology organizations play a crucial role in promoting innovation. The different models of these collaborations and their impact on Azerbaijan's economy should be considered.

The Azerbaijani Model of innovation-driven economic growth

A new conceptual framework grounded in the Quintuple Helix Model [6] is proposed to foster sustainable and innovation-driven economic growth in Azerbaijan. This approach emphasizes the dynamic interaction between five fundamental pillars: the state, business sector, scientific and academic institutions, society, and environmental sustainability. By ensuring the synergy of these components, the model aims to create a robust and self-sustaining innovation ecosystem that enhances economic productivity, technological advancements, and sustainable development.

The Role of the State: A Reformist and Driving Force of Innovation

The government plays a pivotal role in shaping the national innovation landscape by implementing structural reforms, legislative improvements, and financial mecha-

nisms that promote entrepreneurship and technological development. To this end, several strategic actions must be undertaken:
Development of a Comprehensive Legal and Institutional Framework: Establishing a well-defined regulatory environment that facilitates innovation, entrepreneurship, and research commercialization. The creation of a national innovation law will ensure a legally protected and incentivized ecosystem for businesses and researchers.
Financial and Tax Incentives for Innovation Actors: Providing preferential tax regimes, grant schemes, and low-interest credit mechanisms for startups, technology-intensive enterprises, and research institutions. Special financial packages will be introduced to encourage private sector involvement in R&D activities.

Formulation of the 'Azerbaijan National Innovation Strategy 2030': Developing a long-term strategic roadmap to align national innovation priorities with global trends, ensuring integration with digital transformation and the knowledge economy.
Strengthening Public-Private Partnerships (PPP): Encouraging cooperation between state institutions, private enterprises, and academia to develop innovation hubs, technology transfer offices, and smart infrastructure projects (e.g., Smart City and Smart Village initiatives).

Business Sector: Engine of Innovation-Driven Growth
The business sector, particularly startups, SMEs, and large-scale enterprises, plays a crucial role in translating innovative ideas into commercially viable products and services. To facilitate business-driven innovation, the following strategies will be implemented:

- Expansion of the Startup Ecosystem: Strengthening incubation and acceleration programs to foster early-stage entrepreneurial activities. Special innovation funds will be established to support high-potential startups.
- Development of Venture Capital and Risk Investment Mechanisms: Introducing legal and financial instruments that attract foreign and domestic investors to finance technology-based startups and innovation-driven enterprises.
- Promotion of Industry 4.0 and Digital Transformation: Encouraging businesses to adopt automation, artificial intelligence (AI), big data analytics, and blockchain technologies to improve productivity and global competitiveness.
- Enhancing Export Potential of Innovative Products: Developing targeted policies that facilitate the internationalization of Azerbaijani technological

solutions by ensuring their compliance with global standards and connecting local innovators to international markets.

Science and Academia: The Key Driver of the Knowledge Economy

Scientific research and higher education institutions play a foundational role in fostering knowledge-based economic development. Enhancing the research and innovation capacity of Azerbaijani universities and scientific centres will be a strategic priority:

- Transforming Universities into Innovation and Entrepreneurship Hubs: Establishing integrated research centres, startup labs, and technology parks within academic institutions to bridge the gap between theory and industrial application.
- Strengthening STEM Disciplines: Increasing funding and research capacity in critical fields such as artificial intelligence, biotechnology, nanotechnology, and quantum computing, which are essential for Azerbaijan's technological progress.
- Expanding International Collaboration in Research: Establishing joint projects and partnerships with leading global universities and R&D institutions to facilitate technology transfer, knowledge exchange, and researcher mobility programs.
- Enhancing the Commercialization of Scientific Research: Developing a strong patenting and licensing system to transform research outcomes into marketable innovations and industry-driven solutions.

Society: Enhancing Public Engagement and Innovation Culture

A sustainable and thriving innovation ecosystem requires broad societal engagement and the cultivation of a knowledge-based culture. Key initiatives include:

- Promoting a Culture of Creativity and Innovation: Integrating entrepreneurial education and creative thinking into school and university curricula to nurture future innovators and problem-solvers.
- Enhancing Digital Literacy Across Society: Implementing nationwide training programs on digital tools, AI applications, and cybersecurity to empower youth, SMEs, and the broader workforce.
- Encouraging Open Innovation and Crowdsourcing: Establishing digital platforms where citizens, entrepreneurs, and researchers can propose innovative solutions to economic and social challenges.
- Raising Public Awareness and Support for Technological Progress: Conducting national campaigns to promote a positive perception of technological advancements and innovation-driven development.

- Environmental Sustainability: Green Innovations and Sustainable Development.

Innovation should not only drive economic growth but also contribute to environmental sustainability and the green transition. To ensure sustainable development, Azerbaijan will focus on:

- Expanding the Use of Renewable Energy Sources: Increasing the share of solar, wind, and hydro energy in the national energy mix, ensuring energy security and carbon neutrality.
- Adopting Green Technologies and Circular Economy Practices: Encouraging industries to implement eco-friendly production methods, waste recycling systems, and sustainable resource management.
- Developing Smart City and Smart Village Concepts: Utilizing digital governance, smart energy grids, and AI-driven urban management to enhance efficiency and environmental sustainability in urban and rural areas.
- Addressing Climate Change through Technological Innovations: Implementing advanced technologies such as climate-responsive infrastructure, carbon capture systems, and AI-driven environmental monitoring to mitigate ecological risks.
- Implementation of the model and expected outcomes described in below table.

Table 3. Implementation and Expected Outcomes of the Azerbaijani Model

Direction	Implementation Method	Expected Outcome
State Policy	Innovation funds, legal reforms, and regulatory framework.	Attraction of investments, development of innovation activities, and strengthening of entrepreneurship.
Business Ecosystem	Startup accelerators, incubators, and digital platforms.	Creation of new jobs, production, and export of high-tech products.
Science and Research	Education in science, technology, engineering, and mathematics (STEM), investments in scientific research.	Highly skilled workforce and integration into the global market.
Society and Digital Literacy	Awareness programs, open innovation competitions.	Creative and technology-friendly society.
Ecology and Green Economy	Green energy projects, ecosystem protection.	Sustainable development and environmental resilience.

Source: Compiled by the author.

The proposed innovation-driven economic growth model for the Republic of Azerbaijan can be compared with the three main existing economic growth models in the world, namely the Euro-Atlantic (Western), East Asian, and Alternative models, see table 4.

Table 4. Comparison of the Azerbaijani Model with International Innovation Models

Criteria	Euro-Atlantic Model (USA, EU)	East Asian Model (South Korea, Japan, China, Singapore)	Alternative Models (Brazil, Turkey, Russia, etc.)	Azerbaijani Model
State Role	Limited, market-driven	Strong state planning and regulation	Direct and heavy state intervention	State as a regulator and facilitator
Private Sector Involvement	Leading role, strong venture capital	Large corporations dominate, but SMEs are growing	Limited, state-owned enterprises dominate	Support for SMEs and startups
Innovation Ecosystem	Strong university-business ties, developed R&D sector	Government-driven innovation, tech parks, R&D incentives	Limited innovation culture, delayed digitalization	Focus on digital economy, innovation clusters
Economic Orientation	Open, globalized economy	Export-oriented manufacturing and technology	Resource-based, local market protection	Diversification from oil revenues to innovation
Sustainability Focus	Emerging green economy trends	Rapid industrialization, limited sustainability	High resource exploitation, limited green policies	Green economy, smart cities, ecological innovation
Key Strengths	Strong legal framework, free market economy, venture capital	Long-term strategic planning, strong education, industrial hubs	State-driven economic growth, natural resource utilization	Balanced approach with state support, innovation-driven diversification
Key Weaknesses	Market fluctuations, high competition	Over-dependence on government policies, slow adaptability	Weak private sector, slow digital transformation	Need for stronger regulatory reforms, ecosystem development

Source: Compiled by the author.

DISCUSSION

The findings of this study indicate that Azerbaijan has made progress in strengthening its innovation ecosystem; however, systemic challenges continue to constrain the full realization of innovation-driven growth. Key sectors with high

developmental potential include renewable energy, startups, SMEs, the digital economy, and ecological sustainability, aligning with international best practices.

The renewable energy sector is pivotal for economic transformation. Azerbaijan has implemented large-scale green energy projects by the UAE-based clean energy company - Masdar, commissioned multiple hydropower plants, and established renewable energy infrastructure in recently liberated territories, with further projects planned under state programs. Nevertheless, regulatory inefficiencies and limited private sector engagement necessitate reforms to improve the investment climate, streamline regulations, and foster public–private partnerships to fully realize growth and employment potential.

The startup ecosystem, though critical for innovation, remains underdeveloped. Despite the establishment of innovation hubs and venture financing schemes, challenges persist regarding scale, funding access, and entrepreneurial capacity. Policies supporting early-stage financing and knowledge transfer between universities and industry are essential for expanding this sector.

SMEs are central to diversification and competitiveness but face barriers in accessing innovation resources and expertise. Integrating workforce development and education programs with SME needs is crucial to enhance their economic contribution.

Finally, the digital economy offers opportunities for global integration, yet uneven technology adoption and limited digital literacy hinder progress. Investment in human capital—particularly in data analytics, AI, and e-commerce—and incentives for technology adoption are necessary to accelerate digital transformation and foster a culture of innovation.

CONCLUSION

The proposed innovative economic growth model for Azerbaijan represents a strategic framework that aligns global trends with local economic realities to facilitate the transition toward a sustainable, diversified, and digital economy. Unlike the Euro-Atlantic, East Asian, or Alternative growth models, this approach is grounded in the Quintuple Helix framework, emphasizing ecological sustainability, multi-level stakeholder collaboration, and digital transformation. Comparative analysis of Azerbaijan’s innovation performance indicators reveals that, despite improvements in human capital, digital infrastructure, and entrepreneurial activity, the country continues to lag behind leading innovation economies. For instance, in 2023, Azerbaijan had 1,741 full-time equivalent researchers per million inhabitants,

considerably lower than Austria (6,163) and Israel (5,557). R&D expenditure as a share of GDP was only 0.2%, compared to 3.2% in Austria and 5.6% in Israel. Similarly, high-tech production accounted for 12.3% of industrial output, significantly below levels in Austria (45.7%) and Israel (38%), while high-tech exports represented a mere 0.1% of total trade versus 7.9% and 12.3% in Austria and Israel, respectively. Patent productivity remains low, with only 248 applications (residents and abroad), ranking Azerbaijan 72nd globally.

The model addresses these gaps through several key mechanisms. First, economic diversification is promoted by reducing dependence on oil and gas while fostering alternative sectors. Second, innovation and technology transfer are enhanced through strengthened cooperation with both domestic and international innovation centres, alongside the development of a robust startup ecosystem. Third, support for SMEs and startups is ensured through dedicated innovation platforms that extend beyond large enterprises. Fourth, the green economy and alternative energy agenda prioritizes the development of Karabakh and Eastern Zangezur as renewable energy zones, fostering environmentally sustainable growth. Finally, a public-private partnership structure allows the state to maintain its strategic regulatory and incentivizing role while empowering the private sector as the main driver of innovation and economic value creation.

In light of these empirical insights, the proposed Azerbaijani innovative economic growth model is both theoretically sound and practically justified. By strengthening university–industry–government linkages, increasing R&D commercialization, and integrating ecological and digital priorities, the model provides a viable pathway for Azerbaijan to transition from a resource-dependent to a knowledge-driven, sustainable, and innovation-oriented economy. The integration of quantitative targets—such as increasing R&D spending from 0.2% toward at least 1% of GDP, doubling the number of patent applications, and raising high-tech exports to a minimum of 2–3% of total trade—could serve as measurable benchmarks for the successful implementation of this model.

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