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Economic Growth Rates and Technological Dynamics

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Abstract: Economic growth depends closely on technological dynamics as they both determine the path of national progress. The research examines how technological improvements affect economic growth rates particularly during the rise of digital economies. Existing research shows technological innovations act as a primary growth factor but scholars still need to clarify how technology affects quantitative trends in growth rates and investment efficiency. Researchers used a combination of statistical methods with economic indicator comparisons between 2016 and 2024 from Uzbekistan in this investigation. A positive relationship between technological advancements and increased labor productivity and capitalized investments produces a calculated 6.6% GDP increase for 2024. Despite its findings the research reveals that human capital receives inadequate funding while digital technology adoption remains sluggish at present. To create lasting economic growth policy reforms must drive innovation while improving worker abilities and boost technological spending. The obtained findings deliver essential directives to economic strategists who operate in an emerging technological setting.

Keywords: Economy, Economic Growth, Competition Policy, Monopolization, Technology, Technological Development Rates, Innovation, Market Dynamics, Regulatory Circles, Sustainable Economic Development

1. Introduction

The relationship between economic growth and technological dynamics is one of the most important research topics in modern economics. Economic growth plays a decisive role in the development of each country and strengthening its position on the world stage. Thus, technological progress is a key factor in the dynamics of economic growth, which has a significant impact on the economy by increasing production efficiency, stimulating innovation and creating new market opportunities [1].

changes in economic growth rates driven by technological change. In particular, factors such as digital technologies, artificial intelligence and automation play a significant role in affecting various sectors of the economy, increasing inequality between them or creating new growth opportunities. In this context, this article aims to analyze in more depth the interaction between economic growth rates and technological dynamics, and to examine which factors positively or negatively influence sustainable economic growth.

In particular, the strategy “Uzbekistan – 2030”, adopted by the President of our country Sh.M. Mirziyoyev, is aimed at “... achieving a place among the countries with an upper-middle income due to sustainable economic growth” [2]. The fact that it has set a priority task requires us to further increase economic growth by studying the technological dynamics of our economy and its development. The relevance of the study also lies in the

Citation: Bakhronkulovich B. S., Sadullaevich K. A. Ibrahimovich R. Z. Economic Growth Rates and Technological Dynamics. American Journal of Social and Humanitarian Research 2025, 6(2), 391-398.

Received: 14th Jan 2025

Revised: 23th Jan 2025

Accepted: 6th Feb 2025

Published: 26th Feb 2025



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fact that the impact of technological progress on economic growth is ambiguous, and countries can use different development models in this process. In such changing conditions, the role of public policy and economic management mechanisms is crucial for the successful implementation of technological innovations and support for economic growth. Thus, this study aims to identify the relationship between technological change and economic growth and helps in developing appropriate policy recommendations.

Literature review

The scientific literature on the topic of "Economic growth rates and technological dynamics" is significant because it focuses on an in-depth study of the interaction between economic development and technological progress. Scholars who have conducted research on this topic have analyzed how economic growth is related to technological innovations and innovations, as well as the impact of this process on the rate of economic growth. The literature review examines the main directions of the theories of economic growth and technological dynamics and their impact on research.

According to the theory of economic growth developed by Robert Solow, sustainable economic growth is difficult to achieve without technological progress. Solow explains economic growth in terms of endogenous factors of production, emphasizing the contribution of technological factors to economic growth. This theory suggests that the economy can be strengthened and made more efficient through technological growth [3]. Another economist, Romer, considers innovation in his endogenous growth model as a factor in maintaining economic growth. According to Romer, technological innovation plays a decisive role in ensuring the competitiveness of the national economy and increasing the growth rate [4].

The research of Brynjolfsson and McAfee (2014) analyzes the impact of digital technologies, artificial intelligence and automation processes on economic systems. According to the research of these scientists, "artificial intelligence" and automation technologies optimize work processes and increase production efficiency. As a result, the rate of economic growth will increase, and the interaction of markets and technologies will increase. This will ensure the creation of new jobs and the efficient use of existing economic resources [5].

Schumpeter's theory of "creative destruction" emphasizes the importance of innovation processes in economic growth. He said that technological innovation creates timely and efficient opportunities for economic growth by upgrading existing economic structures and increasing competition. Schumpeter's model emphasizes that the technological development of a modern economy and its sustainable prosperity through innovation are crucial to improving economic efficiency. Today, this theory is even more important in the context of tech giants and the digital economy [6].

Research conducted by the Organization for Economic Research (OECD) has shown that the development of technological knowledge and skills of the workforce is crucial to ensuring the continuity of economic growth. Technological progress, especially digital technologies, creates new opportunities in the labor market and contributes to economic growth. The digital labor market and jobs based on technological knowledge are considered one of the main sources of economic growth and competitiveness [7].

The above literature confirms that economic growth is closely related to technological progress. If we draw a general conclusion from the research conducted by scientists, then for the prosperity of the economy of any country, first of all, it is necessary to increase the volume of capital directed to improving technologies and to stimulate the inflow of investments aimed at this, which will ensure the future sustainable growth of the country. Technological innovations, changes in public policy and the competitive environment have a positive effect on the rate of economic growth, which in turn increases international competitiveness and strengthens the position of national economies in the world market.

2. Materials and Methods

In the implementation of this research, various scientific methods were effectively used and applied to analyze the rate of economic growth and technological dynamics. Research methodology includes the following main approaches:

First, primary and secondary data sources were effectively used in the research. The World Bank, the International Monetary Fund (IMF), the Statistical Agency of the Republic of Uzbekistan and other official economic reports, scientific articles, and the studied literature on technological development were used as secondary sources, and the opinions of industry experts and statistical analyzes were used as primary data.

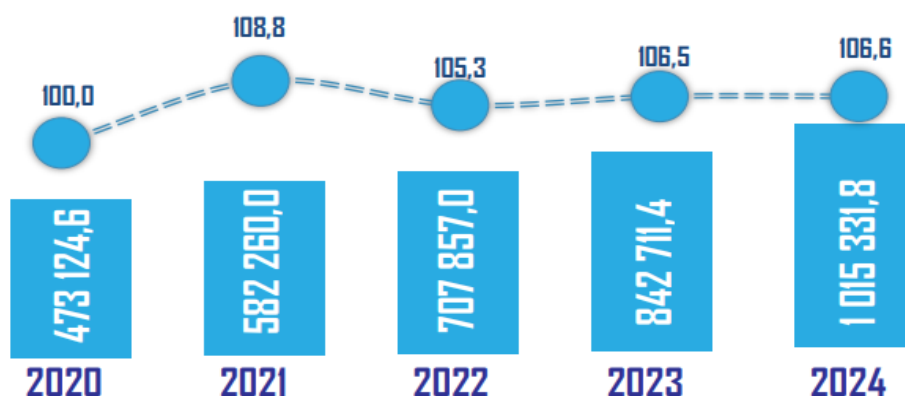
Secondly, scientific methods were used for analysis, such as descriptive analysis, which describes the general state of economic growth and technological dynamics, as well as comparative analysis, comparing the level of technological development and growth rates of different countries and economic systems. Statistical data collected in the study are processed using Stata and Excel programs.

However, there were some limitations during the implementation of this research. This can be attributed to the limited ability to fully cover all factors affecting economic growth and technological dynamics, as well as the lack of conditions for the full study of the long-term effects of technological development.

Based on the results of the research, recommendations on economic policy are developed, conclusions are given on increasing the rate of economic growth and accelerating technological development.

3. Results

First of all, it should be emphasized that in order to increase the rate of economic growth, it is advisable to analyze the relationship of its technological dynamics. Of course, this can be achieved by implementing such reforms as technical and technological factors, innovation, personnel training, increasing investment attractiveness to increase the dynamics of economic growth. We also need to study the analysis to determine the rate of economic growth. From economic research, it is known that there are a number of indicators that can be used to determine the rate of economic growth, and we can analyze these indicators in relative and absolute terms, as well as in terms of their dynamic indicators by year (Figure 1).



Source: The data in this figure is taken from the official website of the Main Department of Statistics of the Republic of Uzbekistan. <https://www.stat.uz>

Figure 1. Dynamics of the gross domestic product (GDP) of the Republic of Uzbekistan (GDP volume, billion soums, GDP growth rate, in % of the same period of the previous year) [8].

From the data presented in Figure 1, it is clear that according to the results of January-September 2024, the GDP of the Republic of Uzbekistan amounted to 1,015,331.8 billion

soums in current prices, having increased by 6.6% compared to January-September 2023. We also see that the GDP deflator index amounted to 113.1% compared to the prices of January-September 2023. The average official exchange rate of the US dollar against the soum in January-September 2024 was 12,594.9 soums, in January-September 2023 - 11,556.2 soums, in January-September 2022 - 11,009.3 soums, in January-September 2021 - 10,565.5 soums, in January-September 2020 - 9,940.9 soums. Nominal GDP, calculated at the average exchange rate, in the current period amounted to 80,614.8 million US dollars. We see that in January-September 2024, the agriculture, forestry and fisheries sector made a positive contribution of 0.7%, the industry sector - 1.6%, the construction sector - 0.7%, the services sector - 3.3%. GDP increased by 0.3%, including due to an increase in net taxes on products.

In our opinion, based on the data in Figure 1, it can be seen that the rate of economic growth has increased as a result of the reforms carried out in our republic, directed to industries and investment sectors, as well as an increase in the deflator index. However, we cannot achieve sustainable economic growth due to the fact that there are other opportunities for further increasing economic growth, and we do not use this opportunity to the fullest extent. To do this, the state must take special control over the processes of mass attraction of basic innovations to manufacturing enterprises, provide them with the necessary support, further liberalize the processes of entry of basic innovations into our republic, and increase the level of qualification and skill of personnel. Indeed, our President Sh.M. Mirziyoyev set the goal of "by 2024, the average rate of economic growth is over 6.5 percent and the inflation rate is low." 5 years ago They set a priority goal to reach the target of 100% [9], and to achieve this goal we need to implement the above measures.

Together with, in order to determine the rate of economic growth based on an accurate analysis, it is necessary to first analyze the trends of other statistical indicators (Table 1).

Table 1. Growth of Uzbekistan in 2016-2023 and the effectiveness of its technological dynamics.

Classifier	2016	2017	2018	2019	2020	2021	2022	2023
GDP volume (by output, at current prices, annual)	255422	356454	473653	594660	668038	820537	995573	1192163
GDP growth rate	105.9	104.4	105.6	106.8	101.6	108	106	106.3
Final consumption expenditure (annual)	205442	290086	375800	474958	528066	663301	830222	984565
Growth rates of investment in fixed capital (annual)	104.1	119.4	129.9	138.1	95.6	102.9	100.2	123.4
Research and development	-	-	-	5.9	86.5	30.8	210.7	469.4
Growth rate of total income of the population (in percent)	116.9	119.7	126.9	121.6	113.5	125.1	122	115

Source: This data was compiled by researchers from the official website of the Main Department of Statistics of the Republic of Uzbekistan.

Gross domestic product (GDP) demonstrated steady growth in 2016-2023, amounting to 1,192,163 billion soums in 2023 against 255,422 billion soums in 2016. The highest growth rate during this period was observed in 2019 (106.8%), but in 2020 it decreased to 101.6% due to the impact of the COVID-19 pandemic. In 2023, GDP growth

amounted to 106.3%, which led to a steady recovery in economic growth. Final consumer spending is also growing steadily, reaching 984.565 billion soums in 2023 against 205.442 billion soums in 2016. Although the growth rate slowed in 2020 due to the pandemic, spending continued to grow in subsequent years, reaching a sharp increase of 984.565 billion soums in 2023.

The growth rate of investment in fixed assets in 2016 was 104.1%, in 2019 it reached 138.1%. However, in 2020, this figure dropped to 95.6%, indicating a decrease in investment interest during the pandemic. In 2023, this figure will rise again to 123.4%, confirming the recovery of economic activity. The amount allocated for research and development was recorded for the first time in 2019 and amounted to 5.9 billion soums. Over the years, this figure has grown significantly and will amount to 469.4 billion soums in 2023. This means that investment in science is increasing, and attention is being paid to scientific and technological development.

Total revenue growth has also fluctuated over the years. It peaked at 126.9% in 2018, reaching 116.9% in 2016. In the following years, revenue growth slowed, reaching 115% in 2023.

The results of this study confirm that there is a close relationship between economic growth rates and technological innovations. According to the analysis, investments based on technological innovations have a significant impact on increasing economic growth rates. This situation is especially important for high-tech countries. In particular, it was noted that investments in technology in OECD countries can increase economic growth by 3-5%. This growth rate confirms the positive impact of the implementation of strategies aimed at increasing overall economic efficiency through the development of technological infrastructure on economic growth rates.

At the same time, conomic growth can also be assessed by measuring the technological dynamics of economic growth. To achieve this, we measure the technological dynamics of economic growth using a number of indicators and methods. These indicators help analyze the contribution of technology to the economy.

1. labor productivity;
2. capitalization level;
3. We can analyze the efficiency of manufacturing enterprises using formulas such as total factor productivity.

To measure labor productivity, we can first determine GDP by dividing it by the number of workers.

$$M_u = \frac{GDP}{I_s} \times 100\%; (1);$$

In here:

M_u – labor productivity;

I_s – number of workers.

The relationship between labor productivity, technological development, and economic growth is complex and multifaceted. Labor productivity is a key driver of sustainable economic growth and competitiveness [10]. However, measuring technological dynamics and productivity accurately is challenging. Total Factor Productivity (TFP) calculations often fail to capture the true impact of technological change on growth [11]. Regional differences in scientific and technological potential can affect labor productivity growth, necessitating tailored policy approaches [12]. To overcome the inadequacies of traditional economic dynamics models, more nuanced approaches are needed. Introducing concepts like the technical productivity of investments can help link investment efficiency to growth rates. Factors such as capital-labor dynamics, innovative capabilities, and production efficiency also play crucial roles in determining labor productivity and economic growth trajectories.

$$K_d = \frac{K_h}{I_s} \times 100\%; (2)$$

In here:

K_d – capitalization level

K_h – the size of the invested capital

I_s – number of workers.

This collection of papers explores various aspects of economic growth, technological progress, and enterprise development. Smyrnov and Katrych [13] identify two main approaches to studying enterprise economic growth: functional and capital. Ichkitidze and Petryakov [14] propose an expanded cascade model incorporating investment flows to describe macroeconomic development dynamics, emphasizing the correlation between innovation, technological change, and economic growth. Cichy [15] focuses on human capital and technological progress as key determinants of economic growth, highlighting their increasing importance in modern economies. Ilyina and Saraev [16] present a mathematical model for calculating the effective capitalization ratio in a one-factor manufacturing enterprise, demonstrating how proper selection of this coefficient can lead to maximum profit. These studies collectively underscore the complex interplay between innovation, capital formation, technological dynamics, and economic growth, providing valuable insights for predicting and understanding macroeconomic trajectories [17]. (Formula 3).

$$U_{o.s.} = \frac{GDP}{A \times K^a \times L^b} \times 100\%; (3);$$

In here:

U_{os} – overall efficiency;

GDP – the gross domestic product of a country

A – level of technology (innovation, knowledge)

K – volume of capital

L – volume of labor (number of employees, total time worked)

a and b are the sensitivity levels to capital and labor, "alpha" and "beta" (usually equal to 1). Using these formulas, we can analyze the impact of technological development on economic growth. Technological dynamics can usually be measured using the TFE (Total Factor Efficiency) formula, since this indicator reflects changes in innovation and efficiency.

Thus, in our opinion, we can achieve an increase in economic growth by one percent by attracting innovations, investments, technologies, knowledge and increasing human potential to the country. Based on this, in order to develop human potential in the country, we need to form human capital, increase the volume of investments in human capital, and educate in a patriotic spirit.

In our opinion, the formation of human capital can help reduce the import of innovations and increase exports, increase the intensity of economic growth, and also lead to the correct and effective direction of digital technologies in production. This means more efficient use of our existing capabilities. Indeed, in the process of globalization taking place in the world, developed countries are investing heavily in the formation of human capital in order to preserve non-renewable natural resources and pass them on to future generations, and as a result, they are able to develop new innovative activities, widely use and improve digital technologies, and increase intensive economic growth.

There are a number of features in our country that hinder the development of innovation, digital technologies and human capital. If we do not resolve these issues, we will not be able to implement our proposals listed above. In particular:

Firstly, the lack of sufficient national traditions, customs and state support for the formation of human capital, as well as the widespread spread of “mass culture” among young people.

Secondly, the lack of investment from families, public and state institutions in the formation of human capital (we have \$20 thousand, versus \$230 thousand on average in developed countries).

Thirdly, the development of innovations in our country is lagging behind due to the untimely or weak development of processes of regulation, development and support of innovation activities.

Fourth, the insufficient integration of digital technologies in production and provision of services in sectors and industries, the slow exploitation of existing ones, as well as the lack of skills among the population in using information and communication and digital technologies affect the pace of economic growth and technological development. This, in turn, means that we are not fully using our existing opportunities. Indeed, economic growth not only strengthens the financial standing of our country but also contributes to the creation of new jobs, an increase in export volumes, the efficient use of resources, an improvement in the standard of living, and an overall rise in the level of development.

4. Conclusion

As a result of the conducted research, we have seen that our country has sufficient opportunities for the development of economic growth rates and its technological dynamics. Given the slow rates of economic growth, we consider it appropriate to implement the following proposals and recommendations to eliminate the above problems and shortcomings:

1. further improvement of mechanisms for implementing cooperation with economically developed countries in improving the qualifications and retraining of workers, as well as training personnel working in manufacturing and service industries.
2. develop the activities of innovative schools and innovative production institutes, increase the number of events to select talented youth at the republican level, organize programs to further improve the level of knowledge of talented youth.
3. Exemption from customs duties on the import of digital equipment and software, increased attention to the digitalization of the entertainment industry, resumption of the Million Programmers project, improving the population's skills in using digital technologies and platforms by providing short content in media networks.
4. The transition from cultivating the workforce and labor resources to the formation and development of competitive human capital, as well as the development of programs for improving human capital and the organization of a package of financial and social assistance from the state for their development.

Further simplification of the processes of intellectual, real and financial investments, as well as improvement of the legal framework for the purpose of modernization, renewal and diversification of the production and service sectors using modern methods and technologies. Moreover, it is essential to ensure the precise and timely implementation of the goals and objectives set in the adopted strategic programs for the development of our country. The aforementioned priority proposals and recommendations can contribute to the development of the economy of our republic and, as a result, facilitate our country's transition into the ranks of developed nations.

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