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MODELING THE ECONOMIC GROWTH OF THE REGION

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Abstract

The purpose of the article is to model the economic growth of the region in the global environment, taking into account not only its the potential competitiveness and innovative activity, but also its Sustainable Development and economic security factors. Scientific economists have developed various methods for assessing the potential of a region, forecasting economic growth, but there is still no methodology for assessing the provision of economic growth, taking into account innovation, competitiveness, economic security and sustainable development of the region, and there is also no single systematized methodology for assessing the above indicators. The existing methods are aimed at assessing innovativeness, competitiveness, economic security or sustainable development of the region individually, not as a whole. In the study, the logical - structural scheme of the interdependence of these groups was based, the evaluation criteria were systematized, the econometric model was developed and in practice conducted from aprobasia. The study used mathematical modeling, regression analysis, multi-factor correlation analysis, forecasting techniques and EXCEL "trend" software. The forecast indicators carried out will allow to determine the impact of innovative activity, competitiveness, sustainable development and economic security factors on economic growth of Bukhara region until 2030, as well as development trends.

Keywords: Competitiveness, economic security, economic growth, innovation, sustainable development

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1. Introduction

The research for factors and conditions that ensure the stability of the region's economy and the achievement of high rates of economic growth has recently been actively discussed through the prism of various theories and approaches. Identifying and analysing the factors influencing the development of the regional socio-economic system in the context of increasing competition between countries and regions is common to many of them. We will focus on the most important ones for this study, without going into the impact of all possible factors, as well as all the concepts in the field of economic growth available in the scientific literature.

"One of the most developed directions in solving the problem of economic growth is the "innovation - economic growth" relationship, which is widely covered in foreign literature" (Mingalyova & Gershanok, 2012, p. 68). However, many works on this topic have a very significant shortcoming, i.e. they are based on a one-sided approach to the analysis of the impact of innovations on the development opportunities of the socio-economic system in the assessment of these relationships. Innovation is positively interpreted only as an engine of growth and development, as a factor that creates new opportunities for production and consumption, as a key condition for ensuring sustainable development. At the same time, as Coad (2021) notes, "Its arrival can be very disruptive because it may not necessarily fit with the local environment, and the changes that are required can be experienced as an imposition" (p. 106).

Another negative feature of the innovation process is the presence of various risks associated with innovation, which are not taken into account when studying the impact of innovation on economic growth in the regions. These include the risk of research failure, loss of financial investments in research, as well as the risk of rejection of the proposed innovation by the market and consumers, and others. Innovation activity is essentially a risky activity, i.e. it threatens the stability of the system, as well as its economic security (Rozenberg & Birdsell, 1995).

The introduction of innovations, also, is often associated with barriers and challenges, including at the institutional level (Mingaleva, 2010, 2011; Mingalyova & Gershanok, 2012; Prigozhin, 1989). A significant barrier that has to be considered is the reluctant acceptance of new knowledge by people, which may affect the results of innovation. It can also lead to an imbalance of the entire system, to a decrease in stability in the region, loss of growth potential, socio-economic shifts, especially if innovations are imposed from top to bottom (Tenyakov, 2009).

The second major area of research in the area of economic growth in the region is the analysis of the interrelationship between "economic security → sustainable development" and "competitiveness → sustainable development" at the regional level. However, "in many studies in this area, these relationships are considered not as key elements of economic growth, but as some "features", "conditions", "criteria", "indicators" and so on that characterize the state of the entire economic system" (Mingalyova & Gershanok, 2012). It should be noted that the current experience of world economic development shows that competitiveness, economic security and sustainable development are not only a "condition for existence and development" of the socio-economic system, but also an important basis for its economic growth.

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Thus, in a number of modern studies, these concepts, i.e., "economic security-competitiveness-sustainable development," are often used as descriptive interrelationships. We propose in this study an approach to using these relationships and their potential in ensuring economic growth in the region, without denying the close connection between these concepts, as well as the complexity of their interdependence in terms of coherence and interdependence. This is a new approach that differs from a number of studies on the region's economic growth, analysis of its elements, economic potential factors, and supply conditions.

2. Problem Statement

The logic of socio-economic development of the world economic system in recent years requires a study of all links and directions of the interdependence chain, as well as the potential negative impact of each of them on the entire system of relations and economic growth in general. In our opinion, the relationship between the concepts of innovation, competitiveness, economic security and sustainability, as well as their place and role in economic growth can be described in the most simplified form in the following logical-structural scheme, as seen in Figure 1 below.

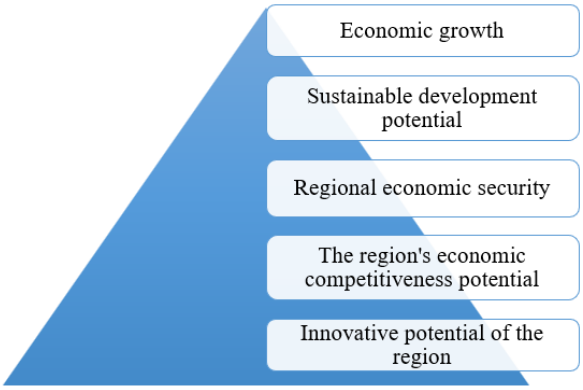

Figure 1. Logical-structural scheme of interdependence of innovations, competitiveness, economic security and sustainable development potential in the economic growth of the region

Figure 1 shows that the gradual implementation of economic growth in the region begins with the implementation of innovative activities of regional businesses, which increase the competitiveness of both themselves and the region's economy as a whole (the first logical step). The assumption that it is a factor is not questioned (the second logical step). It can be said that the economy of the region, which is described as economically secure, has all the conditions and indicators for sustainable socio-economic development at the same time (the third logical step). Finally, sustainable development conditions contribute to the economic growth of the region (the fourth logical step). Thus, the chain "innovation - competitiveness - economic security - sustainable development" plays an important role in ensuring the economic growth function of any socio-economic system.

It should be noted that the relationship between the main elements of the chain is not as simple and straightforward as shown in Figure 1. However, such a scheme would allow the integrated concept of economic growth based on innovation and competitiveness, as we have already mentioned, to incorporate

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the problem of economic security and sustainable development, which has not yet been sufficiently developed in economic education.

3. Research Questions

Proceeding from the above considerations, it is important to develop a multi-factor mathematical model that allows to determine the extent to which innovation, competitiveness, economic security and sustainable development potential of the region affect economic growth in interdependence, as well as the directions of their impact.

4. Purpose of the Study

The aim of the study is to predict economic growth on the basis of interdependence of innovation, competitiveness, economic security and sustainable development potential of the region and determine their impact areas.

5. Research Methods

The purpose of the mathematical model is to ensure economic growth using the economic potential of the region. Since the goal of the mathematical model is to ensure economic growth using the economic potential of the Therefore, all calculations are tied to GDP per capita, which is taken as a general indicator characterizing the economic growth of the region. This connection is ensured through innovation, competitiveness, economic security of the region and indicators of the effectiveness of the potential for sustainable development.

Forecasting the economic growth of the region is based on econometric modelling in the form of a system of regression equations (Norova et al., 2020).

The system of independent econometric equations (1) was chosen as a model:

$$\begin{aligned} Y_1 &= Y_2 + Y_3 + Y_4 + Y_5 + \epsilon_1 \\ Y_2 &= a_{21} X_1 + a_{22} X_2 + \dots a_{2m} X_m + \epsilon_2 \\ Y_3 &= a_{31} X_1 + a_{32} X_2 + \dots a_{3m} X_m + \epsilon_3 \\ Y_4 &= a_{41} X_1 + a_{42} X_2 + \dots a_{4m} X_m + \epsilon_4 \\ Y_5 &= a_{51} X_1 + a_{52} X_2 + \dots a_{5m} X_m + \epsilon_5 \end{aligned} \quad (1)$$

where, Y_1 - GRP per capita, thousand sums (general indicator of economic growth of the region);

Y_2 - the share of innovative products (services) in the total volume of products (services), % (indicator of the effectiveness of economic growth in the innovative direction of the region);

Y_3 - financial results per capita, thousand sums (competitiveness indicator of economic growth in the region);

Y_4 - growth rate of tax revenues, % (indicator of the effectiveness of economic growth of the region in the field of economic security);

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Y_5 - economic growth rates of the region, % (performance indicator of economic growth of the region in the direction of sustainable development).

In the first phase of the mathematical model, a correlation analysis of the economic growth and interrelationships of all four groups of factors was conducted based on the 75 indicators. The correlation of the Y_2 index and the factors of the same group (X_{2i}) and the correlation of the mutual X_{2i} factors to the Y_1 index were studied. Thus, the correlation coefficient was determined by the correlation coefficient of the indicators Y_3, Y_4 and Y_5 one after another and the factors X_{3i}, X_{4i}, X_{5i} belonging to their group with Y_1.

Y_2 - the share of innovative products (services) in the gross product (services), % (indicators of efficiency of economic growth in the region) group factors are all closely related to GDP per capita (except for the share of Internet-connected enterprises and organizations). The low correlation of this indicator indicates that the impact of digitalization of the economy on the economic growth of the region is still insufficient, and the work on the legalization of the shadow economy on the basis of digitization is slow.

When studying the impact of this group of factors on the efficiency of innovation in the region, the cost of technological innovation in relation to the volume of GRP and the share of loans for technological innovation in relation to the volume of GRP and the share of Internet-connected enterprises and organizations are low. It was found that the correlation between these group factors was low.

Thus, Y_3 - per capita financial results (indicator of the region's economic growth in the direction of competitiveness), Y_4 - the rate of growth of tax revenues,% (indicator of the region's economic growth in the direction of economic security), Y_5 - the region's economic growth rate,% (a total of 75 indicators were studied in about 200 combinations, according to the indicator of efficiency in the direction of sustainable development of economic growth in the region). (Y_j, j = 1, 2,…, 5) Multivariate correlation analysis was performed to determine the characteristics, strength and direction of the relationship between the performance indicators (Y_i, i = 1, 2,…, 75), the matrix of pair correlation coefficients were constructed and low-factor factors were not included in the model.

As a result, a linear set of regression equations of the system of equations (1) was constructed by adding a series of important factors, the method of deriving statistically insignificant factors on the Student's criterion, and the following were selected as endogenous variables:

X_1 - the total number of researchers in the region, per capita per 10,000 populations;

X_2 - the share of employees with higher education in the employed, %;

X_3 - inventions, utility models, number of patents for industrial designs per 10,000 populations, units;

X_4 - share of enterprises and organizations producing innovative products, %;

X_5 - level of innovative activity of organizations in the region, %;

X_6 - volume of industrial products per capita, thousand sums;

X_7 - volume of paid services per capita, thousand sums;

X_8 - Expenditures on technological innovations relative to the volume of GRP, %

X_9 - volume of investments per capita, thousand sums;

X_{10} - export volume per capita, thousand dollars;

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X_{11} - volume of lending to the real economic sector relative to GDP, %;

X_{12} - depreciation rate of fixed assets, %;

X_{13} - average total income per capita, thousand sums;

X_{14} - share of imports in food consumption, %;

X_{15} - the size of the shadow economy, billion sums;

X_{16} - 1 sq. km. cost of mining and open pit mines, mln. sums;

X_{17} - household waste recycling rate, %;

X_{18} - Internet access of the population of the region, %;

X_{19} - efficiency of attracted investments, %;

X_{20} - share of social expenditures in total expenditures of the region, %;

X_{21} - production capacity per unit area, mln. sums.

The econometric equations of Bukhara region, which provide economic growth based on the use of economic potential of innovation, competitiveness, economic security and sustainable development, are as follows (2):

$$Y_1 = -589.16 + 9935.3\ Y_2 + 9.144 Y_3 - 65.48\ Y_4 + 77.55 Y_5$$

$$Y_2 = -0.406 + 0.12\ X_1 + 0.008\ X_2 + 0.322\ X_3 + 0.087\ X_4 + 0.135\ X_5$$

$$Y_3 = -134.839 + 0.003 X_6 + 0.054 X_7 + 25.68 X_8 + 0.002 X_9 + 0.967 X_{10} \quad (2)$$

$$Y_4 = 85.579 + 1.475\ X_{11} - 0.967\ X_{12} + 0.009\ X_{13} - 14.385\ X_{14} - 0.009\ X_{15}$$

$$Y_5 = 20.541 - 0.405\ X_{16} - 0.295\ X_{17} + 0.362\ X_{18} + 0.145\ X_{19} + 1.044\ X_{20} + 0.03\ X_{21}$$

The quality of regression models of the system of equations (2) was evaluated on four criteria (multifactor correlation coefficient, standardized determination coefficient, Fisher criterion, Student's criterion) and their results are presented in Table 1.

Table 1. Criteria for evaluating the quality of the regression equation

Multi-factor correlation coefficient	**Standardized determinant coefficient**	**Fisher criterion**	**Summary**
An overall indicator of the region's economic growth $Y_1 = -589.16 + 9935.3\ Y_2 + 9.144 Y_3 - 65.48\ Y_4 + 77.55 Y_5$			
0.98 Strong correlation dependence	0.93 Due to changes in the factors included in the model the variability of the variable is 93%.	37.86 The regression equation is significant	The model is worthy of research and prediction
An indicator of the effectiveness of the region's economic growth in an innovative direction $Y_2 = -0.406 + 0.12\ X_1 + 0.008\ X_2 + 0.322\ X_3 + 0.087\ X_4 + 0.135\ X_5$			
0.99 Strong correlation dependence	0.98 Due to changes in the factors included in the model the variability of the variable is 98%.	53.5 The regression equation is significant	The model is worthy of research and prediction
An indicator of the effectiveness of the region's economic growth in the direction of competitiveness $Y_3 = -134.839 + 0.003 X_6 + 0.054 X_7 + 25.68 X_8 + 0.002 X_9 + 0.967 X_{10}$			
0.95 Strong correlation dependence	0.82 Due to changes in the factors included in the model the variability of the variable is 82%.	10.13 The regression equation is significant	The model is worthy of research and prediction

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An indicator of the effectiveness of regional economic growth in the field of economic security $Y_4 = Y_4 = 85.579 + 1.475\ X_{11} - 0.967\ X_{12} + 0.009\ X_{13} - 14.385\ X_{14} - 0.009\ X_{15}$			
0.96 Strong correlation dependence	0.86 Due to changes in the factors included in the model the variability of the variable is 86%	13.8 The regression equation is significant	The model is worthy of research and prediction
An indicator of the effectiveness of the region's economic growth in the direction of sustainable development $Y_5 = 20.541 - 0.405\ X_{16} - 0.295\ X_{17} + 0.362\ X_{18} + 0.145\ X_{19} + 1.044\ X_{20} + 0.03\ X_{21}$			
0.97 Strong correlation dependence	0.84 Due to changes in the factors included in the model the variability of the variable is 84%	10.41 The regression equation is significant	The model is worthy of research and prediction

Analysis of the obtained system of regression equations (2) allows an economic interpretation of the parameters of the regression equations and draws the following conclusions:

1. Increasing the contribution of innovation products (services) in the volume of the total product (services), which is an indicator of the innovation direction of the economic growth of the region, by 0.01 percent, allows to increase the GDP per capita by an average of 1401.87 thousand sums. This includes the effective use of the region's intellectual potential, such as an increase in the total number of researchers in the region, an increase in the number of employees with higher education, inventions per 10.000 people, utility models, an increase in the number of industrial patents, as well as the growth of innovative enterprises and the effective use of the region’s innovation potential, such as an increase in the level of innovation activity of organizations in the region. It is expedient to focus on the development of its intellectual and innovative potential on the basis of the above indicators included in the model in developing the economic growth strategies of the region.
2. The increase of the GRP per capita by 1.0 thousand sums will increase the per capita financial results, which is an indicator of the competitiveness of economic growth in the region, by an average of 73.8 thousand sums. This includes the volume of industrial production per capita, the volume of paid services per capita, the cost of technological innovations relative to the volume of GRP, the volume of investment per capita, the volume of exports per capita, investment and export potential are important.
3. The growth rate of tax revenues, taken as an indicator of the effectiveness of economic growth in the region, has had a negative impact on GDP per capita. However, if it grows by 15.04%, GRP per capita is likely to increase by 1.0 million sums. Not all economic security factors have a positive impact on economic growth. While the real economic sector had a positive impact on GDP and average per capita income (financial capacity), the share of imports in food consumption, the rate of depreciation of fixed assets and the size of the shadow economy had a negative impact. The region's economic growth strategies need to develop management capacity aimed at ensuring food security and solving the problems of modernization of fixed assets. The problem of the shadow economy requires separate research.

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4. Only a 29.6% increase in the region's economic growth rate, which is an indicator of the region's economic growth in the direction of sustainable development, can increase the GDP per capita by 1.0 million sums. In this case, 1 sq. km. the value of the mining industry and open pit mines corresponding to the area, the level of recycling of household waste has a negative impact. This indicates the need to pay more attention to the efficient use and management of natural resources and environmental potential, which are factors of sustainable development in ensuring economic growth in the region. Provision of the population of the region with Internet (digitization potential), efficiency of attracted investments (entrepreneurial potential), share of social expenditures in the total expenditures of the region (human resource potential), production volume per unit area (production potential) for sustainable development and sustainable economic development had a positive effect on growth. It is necessary to pay special attention to the development of the above-mentioned potential in the development of criteria for sustainable development in Uzbekistan in accordance with the International Concept of Sustainable Development.

Table 2. The impact of innovation, competitiveness, economic security and sustainable development potential on the economic growth of the region

		The economic potential of region	
		Positive effect	**Negative effect**
Economic growth	Innovative development	Intellectual potential Innovative potential	
	Competitiveness	Industry and service potential; Investment potential; Export potential.	
	Economic security	Financial potential	The potential for managing economic security factors
	Sustainable development	Digitization potential; Entrepreneurial potential Human resource potential; Production potential.	Potential for the use of natural resources (reserves) environmental potential

Thus, Table 2 summarizes the results of research on the effective use of economic growth in the interdependence of the region's innovation, competitiveness, economic security and sustainable development potential.

6. Findings

In the next stage of our study, we calculate the forecast indicators in the EXCEL program based on the system of regression equations (2). The calculation of forecast indicators was carried out in two stages. In the first stage, the performance indicators of economic growth and its components of innovation, competitiveness, economic security and sustainable development potential were calculated using the EXCEL List Forecast until 2030 on the basis of data from 2008-2020, denying their

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interdependence. In the second stage, the GRP, which is the overall performance indicator of the region's economic growth, was forecasted and compared using the EXCEL Trends Program until 2030, based on the impact of its innovation, competitiveness, economic security and sustainable development potential performance indicators (Table 3).

Table 3. Forecast of regional economic growth until 2030

9.5	An indicator of the region's economic growth efficiency		The innovative potential of the region is an indicator of efficiency	The competitive potential of the region is an indicator of efficiency	The economic security potential of the region is an indicator of efficiency	The sustainable development potential of the region is an indicator of efficiency
	Y_1- GRP per capita, thousand sums					
	Simple progno-sis	Prognosis under the influence of factors	Y_2 - contribution of innovative products (services) to the total volume of products (services),%	Y_3 - financial results per capita, thousand sum	Y_4 - growth rate of tax revenues,%	Y_5 - economic growth rates of the region,%
2020	16288.70		1.38	351.40	128.90	110.90
2021	16273.42	12433	1.31	329.82	122.99	114.03
2022	17591.67	13261.45	1.41	361.77	124.99	115.48
2023	18909.92	14077.67	1.50	393.73	126.98	116.93
2024	20228.17	14914	1.60	425.68	128.97	118.38
2025	21546.42	15725.5	1.70	457.64	130.97	119.83
2026	22864.67	16532.71	1.79	489.59	132.96	121.27
2027	24182.92	17369.94	1.89	521.55	134.96	122.72
2028	25501.17	18198.78	1.99	553.50	136.95	124.17
2029	26819.42	19005.45	2.08	585.45	138.94	125.62
2030	28137.67	19843.46	2.18	617.41	140.94	127.07

The forecast results show that the forecast indicators of the region's economic growth, based on simple time series, have high values. However, the amount of forecast indicators made under the influence of all factors is much lower than in the first case. This is due to the fact that the use of the region's innovation and competitive potential factors leads to a sharp increase in GDP per capita, while the impact of economic security and sustainable development potential factors slows down this growth to some extent. If the factors of economic security and sustainable development are not used effectively and purposefully managed economically, only in the case of these indicators in 2026, the GDP per capita will reach the level of 2020.

7. Conclusion

The research concludes that the economic growth of the region is balanced by the components of its innovation, competitiveness, economic security and sustainable development potential, the

development of social relations, the creation of conditions for material well-being, spiritual growth and intellectual development, as well as environmental protection.

At the same time, the priorities of the policy to ensure economic growth in the regions of Uzbekistan should be:

1. Reconstruction of the structure of the economy in accordance with the requirements of the world market and ensuring competitiveness on the basis of innovation and digitization, effective management of regional resources, expansion of production of competitive products.
2. Development of state measures to support the development of high-tech and competitive basic production and industries, supporting areas that may pose an economic risk, ensuring the sustainable development of the region.
3. Assistance in the development of investment activities in the region, the formation of a favorable investment climate that provides investment flows.
4. Development of active social policies aimed at improving the quality of life of the population, promoting healthy lifestyles, reducing stratification and poverty.
5. Formation of a system of economic security and sustainable development management, ensuring the innovative development and competitiveness of the region, the implementation of institutional changes that coordinate the activities of social institutions and contribute to economic growth.

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