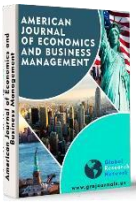

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Article

Multi-factor Econometric Modeling and Development of Forecast Indicators for the Economic Growth of Surkhandarya Region

Alibek Normurodov*[1]

1. Senior Lecturer of the Department of Economics and Management, TIFT

* Correspondence: a.normurodov@tift.uz

Abstract: This article presents a statistical analysis of the gross regional product of Surkhandarya region. Based on the results of statistical analyses, factors that have a strong and direct impact on the volume of the region's gross regional product were identified. Using these findings, a multifactorial econometric analysis was conducted. With the developed multifactorial econometric model, forecast indicators for 2026-2030 were generated. The article also provides conclusions and recommendations.

Keywords: Gross Regional Product, Regional Economic Development, Econometric Modeling, Multivariate Regression Analysis, Investment Per Capita, Employment Level, Average Monthly Wages, Statistical Analysis, Economic Forecasting, Surkhandarya Region

1. Introduction

The socio-economic and ecological development of the Republic of Uzbekistan is based on the fundamental positive changes occurring in its regions. Regional development processes and phenomena are managed through scientifically grounded mechanisms within the framework of the state's territorial policy. Due to existing objective challenges in achieving balanced regional development, there is a need to revise the theoretical and methodological foundations of state territorial policy in accordance with modern trends. In addition, the dynamic development of territorial processes, phenomena and relations requires refinement of the current system of ideas about the organization of territories as a theoretical basis for regional policy of state.

The Decree of the President of the Repub- lic of Uzbekistan from September 11, 2023 No.UP-158 “On Strategy ‘Uzbekistan-2030” mentions such strategic tasks as "Development of industries including regions’ 'drivers' and full preservation of the industrial potential" and "Complex development of territories on the basis realization strategy for urbanization and increasing accessibility to housing for population”[1]. For this purposes, it is necessary to set industrial zones on the basis of modern technologies in the regions, to increase production of new types of energy-saving materials, provide support to enterprises with which they have conlcuded industrial cooperation agreements and form efficient mechanisms for making the region more attractive for investors.

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It is the management of keeping the economic-territorial system working within certain conditions and parameters so that its functioning is stable in the long run, preserving and recovering the naturalness of production environment in addition to harmonizing factors that contribute to improving life quality among present and future generations. From a social perspective, this primarily means the need to enhance living standards and social protection, as it is through these improvements that the tasks of ensuring economic growth and environmental security can be implemented [2].

In our opinion, implementing comprehensive measures to improve the system for modeling the socio-economic development of the region will not only enhance the quality of the forecasts being developed but also create opportunities for regional governing bodies to effectively utilize these forecast calculations in their activities.

Literature Review

When examining the key aspects of regional economic policy, foreign scholars have extensively studied the theoretical and practical issues of reducing economic development disparities in regions and achieving sustainable economic growth. Their works have substantiated scientific, methodological, and practical principles.

As Easterly W. noted, "The direction of decentralization reforms is interconnected with the entire ideology of shaping the country's modern socio-economic model" [3].

The aim of modern regional policy should be to identify and implement hidden and undervalued opportunities for regional development. Considering that decentralization will allow local communities and regions to have a greater impact on their development, changes in the state's regional policy should be directed at establishing partnerships between various levels and sectors of the state, as well as between private and non-governmental sectors [4].

In this regard, Campbell R. McConnell and Stanley L. Brue believed that economic growth helps solve the problem of limited resources and is measured by two interconnected methods: GDP growth over a specific time period or GDP growth per capita [5].

This was their natural defensive reaction to entering the global labor price system when faced with the risk of losing workforce across open borders. All these countries are demonstrating a significant increase in the value of their national products in the short term, and correspondingly, a substantial growth in GDP per capita, which is the main indicator of a country's welfare level. The results obtained from comparing the development of a region with other regions cannot fully reveal the labor market development and the region's potential within the scope of the topic, and do not allow for reliable, scientifically grounded conclusions or correct decision-making. This, in turn, necessitates an approach to the process based on econometric analysis [6].

2. Methodology

The empirical analysis using tS/D framework We apply official statistical data on a yearly basis for Surkhandarya region over the period 2010-2024. The primary data source is the National Statistics Committee of Uzbekistan (NSCU), whose harmonized and publicly available regional macro- economic datasets are used. The database contains a panel of annual data on GRP and some related socio-economic variables which represent labor, capital, and income intensity in the region. Prior to analysis, the data were examined for completeness and internal consistency to ensure their suitability for econometric modeling

The methodological approach is grounded in the theoretical framework of regional economic growth and development, which emphasizes the role of labor resources, investment activity, and income levels in shaping regional output. In this context, the gross regional product of Surkhandarya region was selected as the dependent variable, as it most

comprehensively reflects the scale and dynamics of regional economic activity. The independent variables were the people permanently employed, the intensity of capital investment per capita and the average nominal monthly salary. The criteria for the choice of these indicators was its important theoretical role and empirical relevance in terms of success factors of regional production processes and value generation.

During the first step of analysis, descriptive and correlation analyses were conducted to make sense of trends and relationship between variables. Pearson correlation coefficients were used to estimate the magnitude and direction of the relationship between gross regional product and explanatory factors. This was also a check on multicollinearity among the independent variables. The findings showed a strong, positive relationship between GRP and all the explanatory variables, while the relationships among independent variables were reasonable in that we could proceed with econometric analysis without parameter estimate bias.

With the indicators in different units of measurement and scales, a natural logarithm transformation was performed for all the variables. This transformation made the data homogeneous, diminished heteroskedasticity and made it possible to interpret coefficients as elasticities. On this basis a log-linear multifactor econometric model was specified in which gross regional product is expressed as the function of employment, capital per capita and average wage.

The OLS method implemented in EViews software was employed for the econometric estimation. This approach was chosen since it is efficient in terms of estimation issues and widely used in regional economic studies. Model adequacy and stability were determined based on well known econometric criteria such as coefficient of determination, adjusted coefficient of determination, F-statistic and individual t-statistics. The findings supported a strong utility of the model and the statistical significance of estimated parameters.

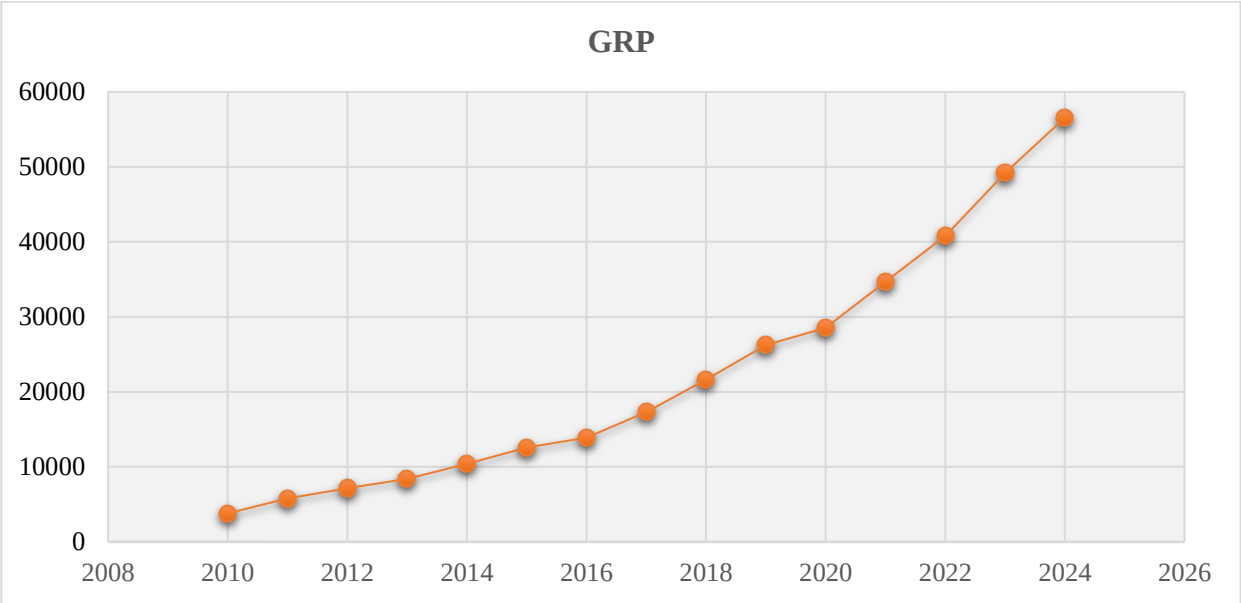
Moreover, a few other diagnostic procedures tested the robustness of our model. The Durbin–Watson statistic was employed to test for autocorrelation in the residuals and absence of serial dependence was confirmed. Prediction accuracy was assessed using the retrospectively calculated Mean Absolute Percentage Error and Theil's Inequality Coefficient. The estimates obtained showed high prediction accuracy and justified the inclusion of all explanatory variables in the final model.

A multivariate forecasting method was then employed to produce forecasts of gross regional product for the next outsample period 2026 – 2030 based on the validated regression equation. Trend equations were initially fit for each explanatory variable over time. These predicted values for employment, investment per capita, and average wages were plugged into the main regression model to predict gross regional product. This choice allowed to make the behaviour of the influent factors consistent with that of the expected regional output.

Notwithstanding the strength of is applied methodology, some limitations need to be recognized. The analysis is based on the aggregated regional data and does not explicitly consider external shocks, institutional changes or structural breaks that might have impact on future economic difference. However, the proposed econometric model may serve as a scientific and robust approach to evaluating and predicting Cyp 1195 economic development of Surkhandarya region, being an effective instrument for designing regional policies.

3. Results and Discussion

Before modeling the volume of gross regional product in Surkhandarya region, it is considered appropriate to examine the changes in this indicator over the years. Below, we present the changes in Surkhandarya region from 2010 to 2024 (Figure 1).



Source. Author's development based on data from the National Statistics Committee of the Republic of Uzbekistan.

Figure 1. Growth trend of the gross regional product in Surkhandarya region.

Based on the data presented in Figure 1, we can observe that the gross regional product of Surkhandarya region has been growing from 2010 to 2024. The most significant growth occurred between 2017-2019, during which the gross regional product increased by 24.7%. In recent years, an average annual growth of 16% can be observed. However, considering the potential of Surkhandarya region, this growth is still not sufficient [7].

From this perspective, to assess the region's capabilities, it is necessary to identify factors influencing the gross regional product indicator and conduct econometric modeling.

For this purpose, the following indicators were selected: the volume of the region's gross regional product (Y) as the dependent variable, and factors influencing it such as the number of permanently employed people in the region (X1), the volume of investments per capita (X2), and the average calculated monthly wage in the region (X3). First, we will examine the correlation between these factors using the correlation coefficient (Table 1).

Table 1. Correlation coefficient of factors affecting the change in the volume of gross regional product of Surkhandarya region.

	Y	**X1**	**X2**	**X3**
Y	1			
X1	0,802307372	1		
X2	0,953747497	0,787815984	1	
X3	0,998451023	0,790134802	0,603050017	1

According to the calculation results presented in the table, all selected factors are strongly and directly correlated with the gross regional product volume (Y) of Surkhandarya region. These factors include the number of people with permanent employment in the region – X1 ($r_{Y,X1}$=0.80230), the volume of investments per capita – X2 ($r_{Y,X2}$=0.95374), and the average calculated monthly wage – X3 ($r_{Y,X3}$=0.99845). It was found that as the selected factors increase, the value of the resulting factor also increases. Since the degree of correlation between the selected factors satisfies the condition $rX1,X2 \leq 0.8$, there is no multicollinearity, allowing the modeling work to continue [8].

Before proceeding with modeling, it is necessary to convert the selected factors to a homogeneous scale, as they have different units of measurement. This can be done by taking the natural logarithm (base e) of each factor. After converting to homogeneous units of measurement, we will continue modeling the indicators using the "Eviews" program (Table 2).

Table 2. Results of the regression equation for factors affecting changes in the gross regional product volume of Surkhandarya region.

Dependent Variable: LN_YAHM_
Method: Least Squares
Date: 01/08/26 Time: 19:27
Sample: 1 15
Included observations: 15

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_VBS_	-0.769777	0.233857	-3.291654	0.0064
LN_AJBIH_	0.171767	0.082651	2.078211	0.0498
LN_OIH_	0.985604	0.155615	6.333618	0.0000
			t_{jad}=2,17881	
R-squared	0.989155	Mean dependent var		9.735512
Adjusted R-squared	0.987348	S.D. dependent var		0.819213
S.E. of regression	0.092147	Akaike info criterion		-1.75400
Sum squared resid	0.101893	Schwarz criterion		-1.61239
F-statistic	56576,66963	Hannan-Quinn criter.		-1.75551
Prob(F-statistic)	0.000000	Durbin-Watson stat		1.995344
	F_{jadval}=8,745			

Using the table values, a regression equation is constructed, and its adequacy, reliability, and potential for future use are examined using a series of qualitative criteria:

$$LnY = -0{,}769LnX1 + 0{,}171LnX2 + 0{,}985LnX3 \qquad (1)$$

If we focus on the significance of the parameters in the developed regression equation (1) according to the t-Statistic criteria, given that tjad=2.1788 when α=0.05 and df=12, it follows that the parameters X1 and X2 are significant based on the condition this>tJad [9]. It is necessary to verify the actual significance or insignificance of the employment factor parameter for the remaining region using retrospective quality criteria MAPE>10 (Mean Absolute Percentage Error) and TIC>1 (Theil's Inequality Coefficient - an alternative measure of forecast accuracy) (Figure 2).

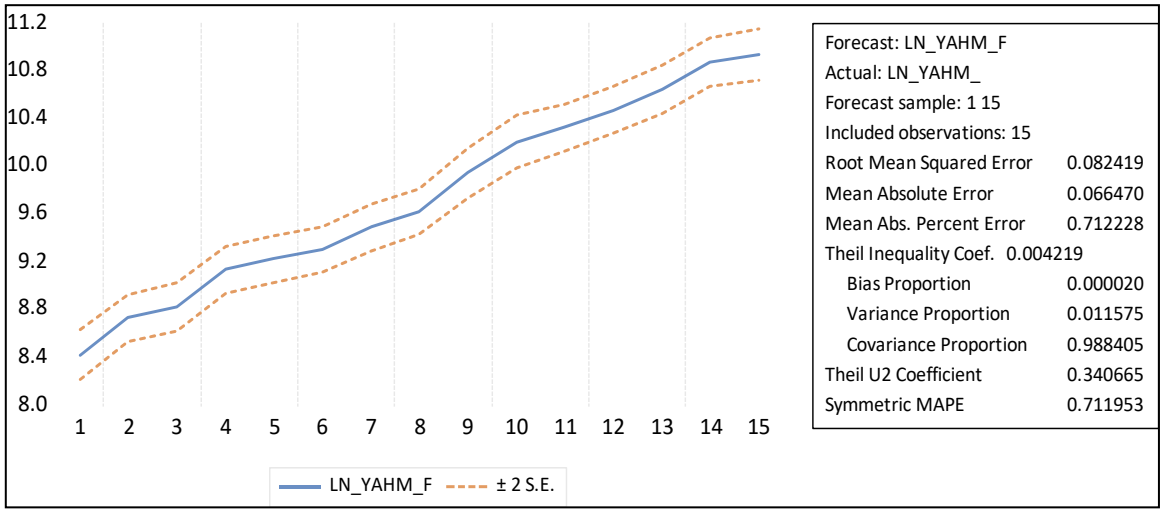


Figure 2. Results of a retrospective examination of the significance of the regression equation (1) parameters.

According to the data presented in Figure 1, MAPE=0.711, which satisfies the conditions MAPE=0.712<10% and TIC=0.0042<1. This, along with the high accuracy of the forecast, indicates the significance of all parameters in the first regression equation. By exponentiating the regression equation (1) based on the properties of logarithms, the following equation is obtained:

$$Y = \frac{X2^{0,171} * X3^{0,985}}{X1^{0,769}} \qquad (1^*)$$

Considering that the calculated Fisher value Fhis=56576.66 is greater than the tabulated value FJad=8.745 at α=0.05 and k1=12; k2=3, the condition FJad<Fhis confirms the significance of the (1*) regression equation. Additionally, with DW=1.995, the absence of autocorrelation indicates the reliability and adequacy of the equation[10], [11].

From an economic perspective, the regression equation suggests that in Surkhandarya region, a 1% increase in per capita investment could lead to an increase of 96.707 billion soums in the region's gross regional product. If the average monthly wage in the region increases by 1%, the gross regional product could grow by an additional 557.05 billion soums. Furthermore, a 1% increase in employment in the region could boost the gross regional product by an additional 429.8 billion soums compared to its 2024 value [12].

Drawing a general conclusion from these results, implementing measures to increase per capita investments to ensure employment in the Surkhandarya region is currently considered more effective. Creating new jobs can increase production volume in the region, which in turn leads to the creation of added value. As production volumes grow, the value of labor capital in the region also increases. The region has sufficient potential to increase employment by expanding the number of business entities and creating new, modern job opportunities [13], [14].

When making decisions on the development of Surkhandarya region, it is crucial to consider the volume of investments per capita, employment rates in the region, and future changes in average monthly wages. To develop these indicators, we will conduct a multifactorial forecast. For this purpose, the primary basis will be the following regression equation, comprised of factors influencing the volume of the gross regional product of Surkhandarya region:

$$Y = \frac{X2^{0,171} * X3^{0,985}}{X1^{0,769}}$$

and from the system of equations dependent on time t=15 for each factor participating in this equation:

- volume of gross regional product: $Y = -5903 + 3546 * t$
- number of people with permanent employment: $X1 = 809{,}9 + 16{,}59 * t$
- investments per capita: $X2 = -1140 + 454{,}1 * t$
- average wage: $X3 = -192411 + 200686 * t$

Using the method of substituting their calculations into the main regression equation, multifactorial forecast indicators of the gross regional product volume for Surkhandarya region are determined (Table 3).

Table 3. Forecast indicators of the gross regional product of Surkhandarya region and factors affecting it for 2026-2030. Author's own calculations.

Years	Gross regional product volume of Surkhandarya Region, measured in billions of UZS	Number of employed individuals	Investment volume per capita measured in thousands of UZS	Average calculated wage in UZS
2026	70425,2728	1091,93	6579,7	4272153
2027	74740,90527	1108,52	7033,8	4538903

2028	79008,30511	1125,11	7487,9	4805653
2029	83227,34979	1141,7	7942	5072403
2030	87398,11015	1158,29	8396,1	5339153

Commenting on the table data, the gross regional product of Surkhandarya region is expected to reach 87,398.11 billion soums by 2030 [15]. This represents a potential increase of 54.5% compared to the base period. Achieving this result is attributed to several factors: an additional increase in employment in the region by 133,390 people, which is a 13% rise compared to the base period; an increase in the volume of investments per capita to 8,396,100 soums, representing a 47.3% growth compared to 2024; and an increase in the average calculated wage by 40.1% compared to the base period.

4. Conclusion

The results of the conducted study confirm that the gross regional product of the Surkhandarya region has demonstrated устойчивый and continuous growth over the period from 2010 to 2024; however, this growth remains below the region's potential given its available labor, investment capacity, and production resources. The descriptive and trend analyses indicate that despite an average annual growth rate of approximately 16 percent in recent years, the region still faces structural constraints that limit the acceleration of economic development. This substantiates the necessity of identifying key growth drivers and applying econometric tools to support evidence-based regional policy decisions.

The econometric analysis conducted within the framework of a multifactor log-linear regression model demonstrates that employment, investment per capita, and average monthly wages exert a statistically significant and positive influence on the gross regional product of Surkhandarya region. The high values of the coefficient of determination and the results of diagnostic tests confirm the adequacy, reliability, and explanatory power of the model. In particular, investment per capita and wage growth appear to play a decisive role in expanding regional output, while employment growth contributes not only to production expansion but also to the formation of added value and income growth within the region. The absence of multicollinearity and autocorrelation further strengthens the validity of the obtained estimates.

The forecasting results derived from the validated econometric model indicate that, under current trends, the gross regional product of Surkhandarya region may reach approximately 87.4 trillion soums by 2030, representing a growth of more than 50 percent compared to the base period. This projected expansion is primarily driven by increases in per capita investment, employment levels, and average wages. The forecasts highlight that even moderate improvements in these key factors can generate substantial cumulative effects on regional output, underscoring the importance of coordinated economic policy measures.

From a policy perspective, the findings suggest that prioritizing investment attraction, job creation, and income growth constitutes the most effective strategy for ensuring sustainable regional economic development. Expanding industrial and agricultural clusters, stimulating the development of processing industries, and strengthening vocational education and retraining systems can significantly enhance labor productivity and employment quality. At the same time, improvements in transport, energy, and utility infrastructure are essential for increasing the investment attractiveness of the region and supporting long-term economic growth.

In conclusion, the study demonstrates that the application of multifactor econometric modeling provides a scientifically grounded and practical tool for analyzing and forecasting regional economic development. The proposed methodological approach and empirical results can be effectively used by regional authorities in the formulation and

evaluation of development strategies aligned with the national priorities outlined in the "Uzbekistan–2030" strategy. Although the analysis is subject to limitations related to data aggregation and potential external shocks, the obtained results offer a reliable analytical basis for stabilizing economic growth and improving the welfare of the population in the Surkhandarya region.proposals.

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