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Article

Modeling the Impact of State Structural Policy on Long-Term Economic Growth in Uzbekistan: Sectoral Dynamics and Econometric Forecasts (2001–2030)

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Abstract: This study investigates the impact of state structural policies on long-term macroeconomic growth in the Republic of Uzbekistan by analyzing sectoral dynamics across agriculture, industry-construction, and services. Utilizing official statistical time-series data spanning 2001–2025, econometric modeling was conducted using Stata 17.0 and SPSS 29.0 software. The Ordinary Least Squares (OLS) regression results reveal that the services sector exhibits the highest output elasticity relative to GDP growth ($\beta = 1.088, p < 0.001$), followed by industry and construction ($\beta = 0.753, p < 0.001$), while agriculture demonstrates lower responsiveness ($\beta = 0.400, p < 0.001$). Furthermore, employing Brown's double exponential smoothing model, sectoral and national GDP projections through 2030 indicate stable and consistent upward trajectories, forecasting national GDP to reach 3,106.5 trillion UZS ($248.5 billion) by 2030 with high explanatory power ($R^2 = 0.997, \text{MAPE} = 8.14\%$). The empirical findings align with Chenery's structural change theory, Lewis's dual-sector model, and endogenous growth frameworks, emphasizing the necessity of accelerating capital reallocation toward high-value-added services and industrial modernization to ensure sustainable economic resilience.

Keywords: State structural policy, economic growth, econometric modeling, Brown double exponential smoothing, cumulative distribution function, sectoral dynamics, Uzbekistan.

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1. Introduction

The sustainable economic development of the Republic of Uzbekistan depends directly on the efficiency of state structural policies, specifically the degree to which productive economic resources are reallocated from low-productivity sectors to high-tech, transformative industries [1], [2]. In contemporary economic conditions, enhancing the impact of structural policy on macroeconomic growth requires not only altering sectoral shares but also driving a qualitative renewal of the entire national economic framework [3], [4].

A primary imperative for accelerating economic growth is industrial diversification and the refinement of cluster-based developmental frameworks. As emphasized by Szirmai [1] and McMillan et al. [2], key priorities involve transitioning from raw-material extraction to high-value-added final product manufacturing, thereby extending national

value chains. To amplify policy effectiveness, strategic investment allocation plays a vital institutional role [5]. Attracting foreign direct investment (FDI) as a vector for technological know-how and modern management expertise-rather than mere capital influx-catalyzes structural modernization [6]. Concurrently, expanding public-private partnerships (PPP) across infrastructure projects builds key resource foundations for sustained economic growth [7].

From a sectoral perspective, elevating agriculture's macroeconomic contribution requires converting traditional farming into an integrated agro-industrial model. Implementing water-saving technologies, refining land lease market mechanisms, and establishing vertical integration with industrial processors represent central structural tasks [8], [9]. To enhance economic flexibility, expanding services-particularly IT, financial-banking, engineering, and advanced medical services-is crucial. This expansion generates a powerful multiplicative impact on overall economic growth by improving operational efficiency across industrial and agricultural entities [10], [11].

The theoretical foundations of structural transformation are deeply anchored in economic literature [3], [4]. Classical structural change theory, formulated by Chenery et al. [10], posits that economic modernization entails a continuous reallocation of labor and capital from primary traditional activities to modern industrial and service sectors. Lewis's dual-sector framework [1] demonstrates how surplus agrarian labor migrates to high-productivity urban industrial units, driving capital accumulation. Furthermore, endogenous growth theory, developed by Lucas [12] and Romer [13], stresses that internal factors-knowledge, technological diffusion, and human capital-serve as the main drivers of productivity differences across sectors. In domestic economic research, studies by Khodjayev [8] and Islamov [9] emphasize that overcoming commodity dependencies requires targeted structural policy mechanisms to channel capital into high-value-added driver industries.

2. Materials and Methods

This study adopts a comprehensive econometric methodology to investigate sectoral interdependencies and forecast long-term macroeconomic trajectories in Uzbekistan using 25-year official statistical time-series data (2001-2025) [14], [15]. Following established time-series econometric frameworks, the computational and statistical analysis was performed using Stata 17.0 and IBM SPSS 29.0 software suites:

- Stationarity and Time-Series Diagnostics: Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) analyses were conducted on time-series variables to identify lag structures, stationarity conditions, and residual properties, ensuring models are free from significant autocorrelation (white noise verification), consistent with standard econometric diagnostic procedures.
- Cumulative Distribution Function (CDF) Analysis: Probability distributions of growth rates across agriculture, industry-construction, and services were evaluated via cumulative distribution function curves to examine data variation, variance concentration, and historical performance spread across sectors [10].
- Linear OLS Regression Modeling: Sectoral GDP dependencies were modeled using Ordinary Least Squares (OLS) regressions, following standard econometric specifications [3], to estimate sensitivity coefficients (β), overall model significance (F-statistics), standard errors, and goodness-of-fit (R^2).
- Brown Double Exponential Smoothing: To account for persistent long-term trend components in macro-level data, Brown's double exponential smoothing model was selected to formulate forecasts for sectoral outputs (2025–2029) and total national GDP (2027–2031). Diagnostic validation was confirmed using Root Mean Squared

Error (RMSE) and Mean Absolute Percentage Error (MAPE), alongside Upper and Lower Confidence Limits (UCL/LCL) [14].

3. Results

The sustainable economic development of the Republic of Uzbekistan depends directly on the efficiency of state structural policies, specifically the degree to which productive economic resources are reallocated from low-productivity sectors to high-tech, transformative industries. In contemporary economic conditions, enhancing the impact of structural policy on macroeconomic growth requires not only altering sectoral shares but also driving a qualitative renewal of the entire national economic framework.

As a priority direction for accelerating economic growth, industrial diversification and the refinement of cluster-based approaches are of vital importance. The primary focus here is directed toward shifting from raw-material extraction to finished goods manufacturing-namely, extending domestic value chains.

In increasing the effectiveness of state structural policy, directing investment flows toward strategically important sectors holds institutional significance. Attracting foreign direct investment not merely as financial capital, but as a source of "know-how" and modern management technologies, acts as a catalyst for structural modernization. Furthermore, developing infrastructural projects on the basis of public-private partnerships generates additional resource foundations that ensure macroeconomic stability.

In our view, elevating the role of agriculture in economic growth requires transitioning the sector from a traditional agrarian model to an "agro-industrial" model, introducing water-saving technologies, refining market mechanisms of land resource utilization, and establishing vertical integration between agriculture and industry.

To enhance economic flexibility, it is necessary to expand services—particularly IT, financial-banking, engineering, and high-tech medical sectors—within the services industry. This direction not only ensures employment but also exerts a multiplicative impact on overall economic growth by increasing operational efficiency across industrial and agricultural entities.

One of the decisive directions for increasing the impact of state structural policy is the removal of institutional barriers for business entities and the improvement of the competitive environment. In the Republic of Uzbekistan, enhancing the impact of structural policy on economic growth is inextricably linked with ensuring inter-sectoral proportionality, supporting technological drivers, and increasing investment attractiveness.

The deepening of inter-sectoral integration analyzed above serves to shape a sustainable and efficient model of economic growth. Consequently, this section of the study sets out to forecast the long-term development trends of the national economy and determine the trajectory of key macroeconomic indicators. Accordingly, official statistical data spanning a 25-year period were econometrically modeled using Stata 17.0 and SPSS 29.0 software packages.

The graph reflects the growth dynamics of agricultural, industrial, and service sectors over time, exhibiting an overall positive growth trend across all branches. In particular, sharp growth rates were recorded in the services and industrial-construction sectors, indicating ongoing structural transformations in the economy. Meanwhile, the agricultural sector is characterized by relatively stable yet slower growth, confirming its consistent role as a traditional sector (Figure 1).

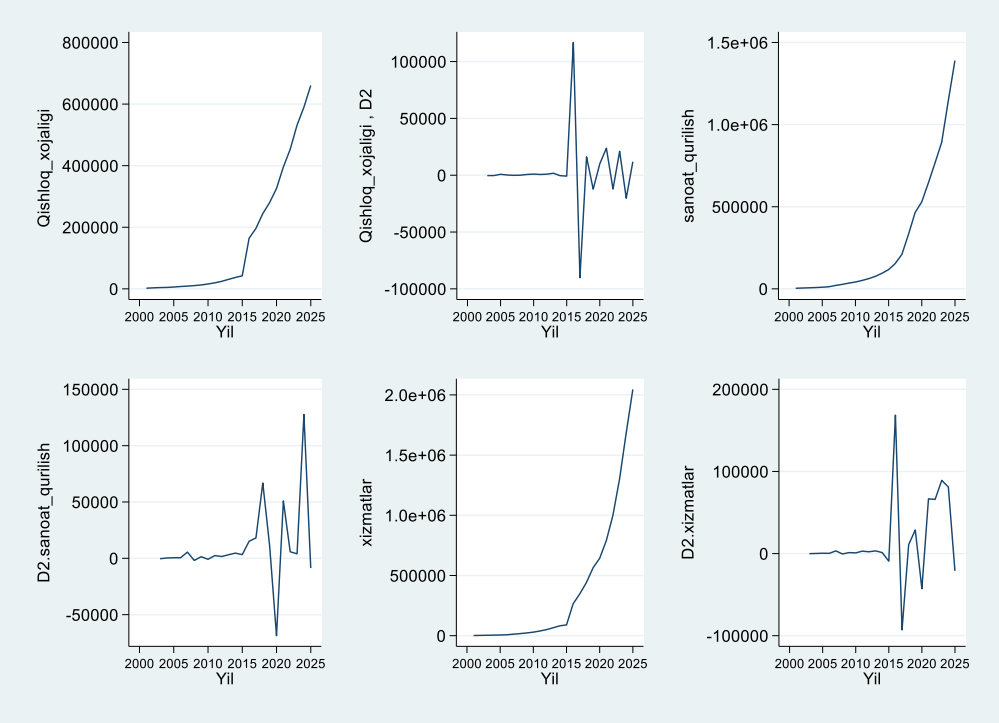


Figure 1. Dynamics of growth rates in the agricultural, industrial, and service sectors of Uzbekistan (2001–2025)

(Source: Compiled based on the author's calculations)

The differential (D2) representations of the graph reveal the instability of growth rates across sectors. Sharp declines and surges have been observed during certain periods, which are explained by the impact of external economic factors, investment shifts, or political decisions. While high growth rates are maintained in the services sector, periodic fluctuations exist in industry and agriculture. Overall, the graphical results indicate that economic growth in Uzbekistan is structurally shifting toward the services and industrial sectors.

In studying the proportionality between economic sectors, it is of significant importance to analyze their growth indicators and resource utilization efficiency using probabilistic statistical methods. Specifically, to comparatively assess the contribution of the agricultural, industrial, and service sectors to economic growth, the Cumulative Distribution Function (CDF) was utilized (Figure 2).

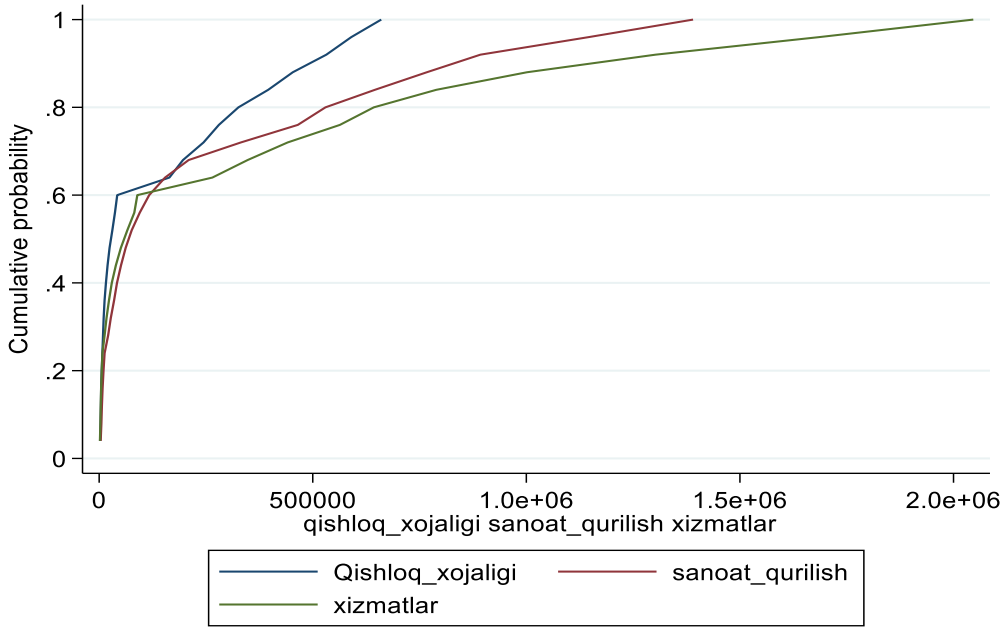


Figure 2. Cumulative Distribution Function (CDF) analysis of agricultural, industrial, and service sectors

(Source: Compiled based on the author's calculations)

Figure 2 illustrates the cumulative probability distribution of indicators corresponding to the agricultural, industrial, and service sectors. As can be seen from the graph, for all three sectors, cumulative probability increases as the values rise, meaning observations accumulate progressively from lower to higher values. Agriculture (blue line) reaches a higher probability level relatively quickly, indicating that values in this sector are predominantly concentrated within the lower and middle ranges.

In contrast, for the services (green line) and industry (red line) sectors, the cumulative curves grow more slowly and encompass a broader range of values. This demonstrates higher dispersion in these branches, signifying a larger variance among values. Particularly in the services sector, maximum values are significantly higher, implying its rapid expansion in recent years.

According to our research model, the observed and fitted values for the three main sectors-agriculture, industry-construction, and services-for the period 2001-2024, alongside forecast results for 2025-2029, are presented. In the graph, the vertical black line indicates the starting point of the forecast (approximately 2025). Additionally, upper (UCL) and lower (LCL) confidence limits are provided to show the probabilistic range of the forecast. Overall, a clear upward growth trend is observed across all sectors.

Table 1. Forecast indicators calculated based on Brown's model

Model		2026	2027	2028	2029	2030
Agricultural sector -Model_1	Forecast	346211.5	379914.8	413618.0	447321.3	481024.5
	UCL	388334.5	427237.2	470940.0	519057.4	570761.5
	LCL	304088.4	332592.3	356296.0	375585.1	391287.6
Industrial-construction	Forecast	761221.79	962629.70	1.22E+6	1.54E+6	1.95E+6

sector -Model_2	UCL	1.07E+6	1.54E+6	2.15E+6	2.95E+6	3.99E+6
	LCL	526216.37	566164.42	630314.26	714252.15	818566.23
Service sector - Model_3	Forecast	1006244	1170613	1334981	1499350	1663718
	UCL	1084978	1281967	1497312	1725522	1963565
	LCL	927511	1059259	1172651	1273178	1363872

(Source: Compiled based on the author's calculations)

In the agricultural sector, relatively slow and stable growth was observed during the period of 2001–2015 (ranging approximately from 50 thousand to 100–150 thousand). Starting from 2016, a sharp growth trend began, reaching approximately 306,294.2 billion UZS by 2025. According to projections, by 2029 this indicator will approach 447,321.3 billion UZS ($35.8 billion), accounting for nearly 13% of GDP. The confidence interval ranges from approximately 375,585.1 billion UZS to 519,057.4 billion UZS, indicating that the sector will continue to grow in the future, albeit with a certain degree of uncertainty.

In the industry and construction sector, growth appears even more rapid and stable. While the value stood around 100–150 thousand in 2001, it increased at a fast pace after 2016, reaching a level of 601,953.8 billion UZS by 2025. According to forecasting results, by 2029 this sector may reach 1.54E+6 billion UZS ($123.2 billion), accounting for approximately 44% of GDP. The confidence boundaries are wider (ranging from approximately 714,252.15 to 2.95E+6), demonstrating that high growth in the industrial sector is accompanied by greater volatility.

The services network holds the largest volume, with the highest values on the graph corresponding precisely to this sector. Standing at approximately 300–400 thousand in 2001, the indicator formed around 859,891.4 billion UZS by 2025. According to forecasts, by 2029 the services sector is expected to reach 1,499,350 billion UZS ($119.9 billion), representing about 43% of GDP. The confidence interval spans from approximately 1,273,178 billion UZS to 1,725,522 billion UZS, confirming that this sector acts as the primary driver of the economy.

4. Conclusion

The forecasting indicators of our research clearly demonstrate the existence of a stable and continuous growth trend in Uzbekistan's GDP. This indicates that the trend component in the economy is strong and that growth will proceed consistently. The results imply that economic activity will expand, and the development of the investment and services sectors will drive GDP upward. The model's forecast confirms a positive, stable, and trend-based development trajectory for the economy of Uzbekistan.

To further deepen structural changes in Uzbekistan's economy, primary priority must be given to developing the services sector. In particular, increasing investments in the digital economy, IT services, logistics, tourism, and financial services is crucial. This will not only accelerate GDP growth but also enhance export potential through the generation of higher added value. Concurrently, it is essential to improve the efficiency of the services sector by developing human capital—namely through education, vocational training, and the support of innovations.

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