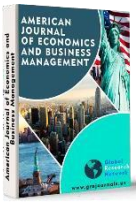

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*Article*

# Analysis of the Efficiency of Recycling Industry Enterprises in the Digital Economy Using Trend and Regression Models

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**Abstract:** The growth of processing industry enterprises is a key element of sustainable socio-economic development, especially in the context of the digital economy, were factors of long-term sustainable development are based on competitiveness, productivity and value-added production. These years of large-scale reforms in Uzbekistan to improve investment climate, to develop private sector, to accelerate technology modernization and to boost the export potential of the country have created a favorable environment for industrial development, confirmed by the dynamics of growth in volumes and export of industrial products and output indicators at regional level. While modeling and forecasting of socio-economic and industrial processes are well-researched (theoretical and empirical), there is still a significant gap in context-specific econometric evaluation of processing industry enterprises in conditions of post-covid recovery and digital transform possibilities. Abstract This study aims to test the possibility of processing industry enterprises development prediction based on the trend and trend regression models, long-term growth patterns for processing industry identification and forecasting scenarios of growth dynamics construction on the state vulnerability data for 2005–2025 period using official statistical data. The results prove that the industrial production shift is approximately uniform, that technological modernization has an increasing effect on the production levels, and that there will be a significant increase in the total and per capita industrial production in the Kashkadarya region for the years 2026–2031 This study combines trend extrapolation, regression analysis and cross-regional comparisons in a consistent quantitative approach for the digital economy setting. The results highlight the importance and need for timely technological updating and the reconstruction of management mechanisms, the establishment of human capital development levels with fair competition, increase in export growth and the most efficient use of resources to facilitate sustainable development of induatri, and national economy – GDP growth.

**Keywords:**: Processing Industry Enterprises, Digital Economy, Marketing, Management Efficiency, Trend, Trend Models and Forecast

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## 1. Introduction

Today, special attention is paid to modern scientific research devoted to the restoration of the current status of processing industry enterprises in socio-economic development. Increasing the competitiveness of processing industry enterprises in the digital economy environment based on attracting new opportunities for effective use of their potential is considered one of the urgent issues today [1][2].

The trends observed in the industry have become the basis for comprehensive reforms aimed at developing industrial enterprises in Uzbekistan as a strategic sector of

the national economy with high productivity, and in 2025, the Republic of Uzbekistan will produce 55.8 trillion soums of industrial products, an increase of 4.3% compared to January 2024, creating a favorable institutional and socio-economic environment. Today, "In recent years, systematic reforms have been implemented in our country to create a favorable investment climate and protect the rights and legitimate interests of private property owners [3]. At the same time, the delay in the transition to market mechanisms in some sectors and large enterprises where the state share is retained is hindering the launch of new types of competitive products, the introduction of advanced technologies, increasing labor productivity, and the creation of new jobs with the active involvement of private capital [4]. The main goal of supplying finished products with added value to the world market is that if raw materials are deeply processed and released to the market in a state ready for consumption, first of all, our people will be provided with jobs, the value of our money will increase, our markets will be saturated with various products, and, of course, it is a guarantee of increasing the well-being of our people. Taking this into account, practical measures are being consistently implemented in our country to ensure the further development of this sector. A number of Decrees of the President of the Republic of Uzbekistan were issued on the accelerated development of processing industry enterprises [5][6].

1. Decree of the President of the Republic of Uzbekistan dated December 27, 2024 "On Amendments to Certain Documents of the President of the Republic of Uzbekistan in Connection with the Harmonization of Export Support Measures with the Agreements of the World Trade Organization, as well as on Recognizing Some of Them as Invalid";
2. Decree of the President of the Republic of Uzbekistan dated December 27, 2024 "On Further Measures to Ensure Equal Conditions for Entrepreneurs and a Fair Competitive Environment";
3. Decree of the President of the Republic of Uzbekistan dated December 24, 2024 "On Additional Measures to Improve State Control in the Field of Industrial, Radiation and Nuclear Safety" [7];
4. Decree of the President of the Republic of Uzbekistan dated December 20, 2024 "On measures to establish a new system of ensuring high economic growth and employment in the regions and to increase the role and responsibility of local khokimiyats in this regard";
5. Decree of the President of the Republic of Uzbekistan dated November 14, 2024 "On measures to reliably protect the rights and legitimate interests of entrepreneurs";
6. Decree of the President of the Republic of Uzbekistan dated September 6, 2024 "On measures to effectively use the investment potential of land resources in the implementation of entrepreneurial and urban development activities";
7. Decree of the President of the Republic of Uzbekistan dated December 29, 2025 "On additional measures to consistently continue financial support for industrial projects";
8. Decree of the President of the Republic of Uzbekistan dated December 18, 2025 "On additional measures to improve the investment climate in the capital market" [8];
9. Decree of the President of the Republic of Uzbekistan dated December 10, 2025 "On additional measures to popularize non-cash payments and reduce the share of the shadow economy";
10. Decree of the President of the Republic of Uzbekistan dated October 4, 2025 "On additional measures to accelerate the development of industry in the regions and attract industrial enterprises to export".According to the World Statistical Organization (UNIDO), much of the economic success of developing and newly industrialized countries is explained by profound structural changes in industry, especially in the manufacturing sector. In particular, these countries account for 60-65 percent of the value added in the global manufacturing sector and 65-70 percent of exports [9].

According to research, the industrial sector also plays an important role in job creation. In particular, the creation of one job in the manufacturing industry leads to the creation of two or three jobs in other sectors [10].

oday, the development of the industrial sector also plays an important role in our country's economy. In particular, this sector accounts for 27.8 percent of the value added of sectors in the republic's GDP, 16.4 percent of total employment in the economy, and 27.6 percent of investments in fixed capital by type of economic activity.

**Literature Analysis**

Theoretical and practical aspects of modeling and forecasting socio-economic processes, the construction of inter-sectoral balance models, and the econometric study of technical progress and economic growth have been thoroughly studied in the scientific works of foreign economists such as V. Leontiev, R. Lucas, M. Hirooka, J. Madsen, etc [11].

The issues of modeling and forecasting of manufacturing processes in the processing industry, multi-criteria optimization of production, regional development of the industry and classification of its multidimensional dynamics have occupied a wide place in the scientific research of Rodrik D., Hausmann R., Hwang J., Szirmai A., Lin J. Y., M. McMillan [12].

As in other countries, the issues of modeling socio-economic processes have been the subject of scientific interest of economists of our republic. In particular, in the scientific works of our country's famous economists V.Q.Kobulov, S.S.Gulyamov, B.Y.Khodiyev, B.T.Salimov, X.S.Mukhitdinov, the issues of modeling and forecasting production, modeling socio-economic processes in complex environmental conditions, forecasting development trends of small businesses, factors and econometric models of sustainable socio-economic growth, modeling the formation and development of agriculture and the rural labor market have been deeply and widely studied [13].

The scientific research of the above-mentioned scientists has its place and importance within the scientific work done in this direction. However, each problem requires a unique solution for a specific time and place.

## 2. Material and Methods

This research employs a quantitative econometric approach for modeling the development dynamics of processing industry enterprises in terms of trend models and modeling forecasting. The research is based on regional official statistical data for the period 2005–2025. Data were organized and cleaned by years, so that the time-series data were processed to be consistent and comparable across years. The first analytical technique used is trend analysis because linear and graphical trend models were developed to find long-term growth tendencies and structural changes in industrial production. Using time as a variable, regression equations were estimated to reflect the functional dependence of output indicators on time, which allowed for the determination of growth rates and cyclical dynamics. Trend functions were estimated and then used to extrapolate back the values of the main production volumes and per capita industrial output for 2022–2026. It was also utilized for comparative regional analyses to evaluate differences in industrial concentration and development levels between territories. Percentage shares, growth coefficients, and structural shares were assessed using descriptive statistical tools. Incorporating elements of economic growth theory and regional development modeling, the methodological framework is characterized by both theoretical depth and empirical grounding. The graphs and tables were used to present data in a more clear and reliable way. The concept of the belt ensures that the conclusions about the efficiency of management and development prospects of processing industry enterprises will be based on comprehensive quantitative assessment.

## 3. Results and Discussion

In recent years, the industrial sector of Uzbekistan has been demonstrating active growth as the main driver of the country's economic development. Strategic decisions taken by the state, in particular, reforms aimed at supporting industrial enterprises and increasing their competitiveness, are yielding significant positive results. According to the State Statistics Agency under the President of the Republic of Uzbekistan, in 2023 the volume of industrial production reached 49.5 trillion soums, which is an increase of 61% compared to 2019. This indicator indicates the work carried out on technological modernization of industrial enterprises and increasing production efficiency [14].

The volume of industrial exports amounted to 12.3 billion US dollars in 2023, an increase of 30% compared to 2019. Industrial enterprises specializing in export are managing to increase their competitiveness by introducing new technologies and ensuring product quality at the level of international requirements.

State programs for technological modernization and digitalization of industrial enterprises are being implemented in Uzbekistan. Within the framework of the "Digital Economy Program" adopted in 2022, automation technologies have been introduced at industrial enterprises. For example, enterprises of the automotive, textile and chemical industries are achieving a reduction in product costs and an increase in efficiency by digitizing production processes.

Speaking about the use of econometric models in managing the development of processing industry enterprises in our country, we mean the creation of an interactive map of the country and its ecological system, which includes a single database of existing tourist resources of tourist regions, their tourist potential [15].

There are several theoretical directions in economics for increasing labor productivity in industrial enterprises. The two most important of these directions are:

— Technological modernization: One of the most effective ways to increase labor productivity in enterprises is the integration of technology.

Automation, robotics, and digitalization can lead to a reduction in manual labor and an increase in overall liquidity as a result of the implementation of processes. By investing in technological activities in the manufacturing sector, industrial enterprises can optimize their operations and assign more strategic tasks to workers.

— Skilled workforce: Providing training programs and training opportunities for employees can have a significant impact on labor productivity. Well-trained workers are more efficient, make fewer errors, and contribute to the smooth running of the work process. Continuous learning initiatives help employees stay informed about industry trends and best practices, which ultimately increases the level of efficiency within the enterprise [16].

However, the resource potential of each region differs in terms of quantity and quality of resources. A comprehensive assessment of the geographical tourism potential of our country by international experts revealed its high level and the high attractiveness of tourist areas for foreign and domestic tourists. Therefore, it is advisable to use the mechanism of public-private partnership in the formation of a marketing budget aimed at bringing Uzbekistan to the world tourist market. This will reduce the level of uncertainty in the information system about the sources of development of ecological tourism in the regions, more effectively promote regional tourist products, and form a positive tourist image of the region (Table 1).

**Table 1.** The volume of processing industry output and industrial output per capita in our republic

| Years | Volume of industrial output in Kashkadarya region (in billions of soums) | Industrial output per capita in Kashkadarya region (in thousand soums) |
|---|---|---|
| **2005** | 1 436,3 | 598,6 |
| **2006** | 2 018,2 | 826,7 |
| **2007** | 2 446,4 | 984,1 |
| **2008** | 3 306,6 | 1303,6 |
| **2009** | 4 461,6 | 1722,8 |
| **2010** | 4 957,5 | 1857,1 |
| **2011** | 5 043,6 | 1833,8 |
| **2012** | 6 076,4 | 2166,7 |
| **2013** | 6 849,4 | 2392,1 |
| **2014** | 7 194,7 | 2458 |
| **2015** | 8 721,9 | 2914,8 |
| **2016** | 9 632,2 | 3150,7 |
| **2017** | 7 351,2 | 3509,9 |
| **2018** | 9 992,0 | 4568,0 |
| **2019** | 12 562,6 | 6270,9 |
| **2020** | 14 612,3 | 4417,4 |
| **2021** | 18 771,9 | 5567,2 |
| **2022** | 21 655,7 | 6 945, 5 |
| **2023** | 24 980,6 | 8 053,7 |
| **2024** | 28 836,5 | 9 621,1 |
| **2025** | 33 269,2 | 11 119,8 |

**Table 2.** Forecast of industrial output volume and per capita industrial output for Kashkadarya region

| Years | Volume of industrial output in Kashkadarya region (in billion soums) | Industrial output per capita in Kashkadarya region (in thousand soums) |
|---|---|---|
| **2026** | 52958,7 | 8270 |
| **2027** | 65 669 | 8 915 |
| **2028** | 81 429 | 9 610 |
| **2029** | 100 972 | 10 360 |
| **2030** | 125 205 | 11 168 |
| **2031** | 155 254 | 12 039 |

As you can see in Table 2, the trends in the volume of industrial output and per capita industrial output for the Kashkadarya region are projected for 2026-2031. Based on this, the volume of industrial output in the Kashkadarya region is projected to increase by 2.36 times by 2031 compared to 2026, and the per capita industrial output is projected to increase by 1.35 times by 2031 compared to 2026.

## 4. Conclusion

It is necessary to study the specific scientific and methodological foundations of the management system of marketing activities of enterprises of the digital economy and the

processing industry, determine the main directions of activity in this area, create an effective management system in the industry, as well as form the management activity and structure, and develop a mechanism for effective management of the activities of enterprises. Based on the production efficiency of the regions, increasing the effectiveness of management mechanisms in the development of enterprises of the processing industry, and effectively organizing the organizational and economic mechanism of the activities of enterprises should be considered as the main direction in ensuring economic development. The organizational and economic mechanism for the development of marketing activities of enterprises of the processing industry includes management subjects, management functions, management objects, communication system, management methods, management goals and objectives, and requires their operation in an effective system. All elements of the organizational and economic mechanism are inextricably linked, and their complementarity is the main criterion for their effective activity in the market. Regression analysis confirmed that the introduction of new technologies has a significant positive impact on production volumes. The use of innovative technologies by industrial enterprises is a decisive factor in increasing their global competitiveness.

**Suggestions**

Based on the results of the study, the following proposals were developed to further increase the competitiveness of industrial enterprises:

It is necessary to increase the volume of investments to expand modern technologies and automation processes at industrial enterprises.

It is advisable to provide tax incentives and credit facilities to enterprises implementing innovative technologies.

It is necessary to increase the financial and technological potential of industrial enterprises by creating a favorable investment environment for foreign investors.

It is necessary to improve the infrastructure of special economic zones and increase investment flows by introducing additional benefits.

It is necessary to train qualified personnel who can use digital technologies in enterprises and implement programs for continuous updating of their knowledge.

It is necessary to strengthen cooperation between scientific research institutes and industrial enterprises and focus on the production of innovative products.

Special attention should be paid to ensuring the compliance of local products with international standards and expanding the geography of exports. It is advisable to increase the competitiveness of industrial enterprises in international markets by assisting them in marketing and branding.

Ensures the economical use of energy and raw materials.

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