

Article

Analysis of Development Trends and The Current State of Industrial Sectors

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Abstract: This study examines industrial development trends in Kashkadarya Region, Uzbekistan, during 2015–2024. Drawing on official statistics, it analyses production, foreign trade, innovation, employment, and investment through trend analysis and regression models. Manufacturing output increased from UZS 3,536.7 billion to UZS 32,080.1 billion, while innovative manufacturing output rose from UZS 761.3 billion to UZS 6,520.0 billion. Industrial employment grew faster regionally than nationally. Industrial and manufacturing trade balances remained negative in most years, with surpluses recorded only in 2022–2023. The regression results indicate relationships between exports and innovative output, innovation and imports, and investment and industrial production. The findings emphasise the importance of improving investment utilisation alongside expanding investment to support regional industrial development.

Keywords: Regional Industrial Development, Kashkadarya Region, Manufacturing, Innovation, Foreign Trade, Investment Efficiency, Trend Analysis

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1. Introduction

At the regional level, economic growth develops in accordance with the underlying patterns that shape a region's distinctive socioeconomic conditions. This process unfolds over a particular period, and conditions at specific points within that period are represented by a trend line. Changes in the trajectory of this line determine the direction of economic growth. A trend-based approach is therefore used to analyse the development of an economic sector over time. The quality and substance of the resulting analysis depend on the indicators included in the observation of trends.

On this basis, the development trend of industrial sectors can be understood as the direction of change in their principal economic indicators within a continuously expanding dynamic process. A further focus of trend observation is the set of indicators that provides a detailed account of socioeconomic conditions within these sectors. Approaches to selecting indicators for trend observation change over time, primarily because economic processes are influenced by the technologies, methods, and other factors characteristic of a particular period.

Industrial sectors in Uzbekistan, including those in Kashkadarya Region, have developed distinctive trends over an extended period.

Literature Review

The literature on industrial development distinguishes growth in the scale of production from improvements in productivity. Rodrik [1] finds evidence of unconditional labour productivity convergence in formal manufacturing industries across countries. However, the contribution of manufacturing to economy-wide convergence

depends on its employment share and the pace of industrialisation. Herrendorf et al. [2], using a different dataset with broader sectoral coverage, find no evidence of unconditional manufacturing productivity convergence over 1990–2018. These contrasting findings show why the coverage and definition of industrial indicators matter when interpreting development trends. For a regional study, rising production values alone cannot establish whether productivity is converging towards that of more advanced economies.

Trade provides a second perspective on industrial development. De Loecker [3] examines learning by exporting and finds productivity gains associated with entry into export markets among Slovenian firms when productivity is allowed to evolve endogenously. This study links export participation to firm performance while also showing that the econometric treatment of productivity affects the conclusions. Its relevance to regional industrial analysis lies in the distinction between observing export growth and identifying the mechanisms through which exporting may influence productive capabilities.

Imports can also contribute to industrial upgrading. Goldberg et al. [4] examine Indian firms and find that access to new imported intermediate inputs supports the introduction of domestic products. Their findings suggest that imports may expand the range of inputs available to producers and relax technological constraints. Consequently, an increase in industrial imports need not have a single interpretation: it may reflect purchases that support production as well as purchases that compete with domestic output. Applying this distinction requires information about the composition of imports, because aggregate trade values do not identify the use of imported products.

The relationship between investment and industrial performance also depends on resource allocation. Hsieh and Klenow [5] use manufacturing establishment data from China and India to examine how differences in the allocation of capital and labour can reduce aggregate total factor productivity. Their analysis provides a basis for distinguishing the amount of investment from the efficiency with which productive resources are allocated. At the national level, the World Bank [6] identifies Uzbekistan's reliance on capital accumulation and stresses the importance of productivity, competition, infrastructure, and trade integration. This perspective is relevant to the article's concern with both investment growth and investment efficiency in Kashkadarya's industrial sectors.

Innovation indicators require equally careful interpretation. The Oslo Manual distinguishes implemented product and business process innovations and provides guidance on collecting and interpreting innovation statistics [7]. The value of innovative products represents one dimension of innovation-related activity; it does not, by itself, measure every form of innovation or its productivity effects. Taken together, these studies support examining production, external trade, innovation, employment, and investment as related but distinct dimensions of industrial development. They provide a conceptual basis for the indicators considered in this article, without implying that findings from other countries establish the same relationships in Kashkadarya.

In Uzbekistan, econometric modelling and forecasting have been applied to the efficiency of industrial enterprises [8], the public services sector [9], hotel and catering enterprises [10], trading enterprises and retail systems [11], [12], agricultural production and agrocluster systems [13], [14], and small business and entrepreneurship [15], [16]. However, comprehensive assessments of the development trends of industrial sectors at the regional level that simultaneously cover production, external trade, innovation, employment, and investment remain limited. This study addresses this gap by analysing industrial development trends in Kashkadarya Region during 2015–2024 on the basis of a system of trend indicators and regression models.

2. Materials and Method

2.1. Data

The study established a system of indicators intended to capture industrial development trends comprehensively and to improve the relevance, accuracy, and quality of assessments of changes in the level of development. The graphical data were prepared by the author using official statistics from the Statistics Agency under the President of the Republic of Uzbekistan and the Kashkadarya Regional Statistics Department.

The study covers the period 2015–2024 and uses annual data on industrial output by sector (mining and quarrying; manufacturing; electricity, gas, steam, and air conditioning supply; and water supply, sewerage, waste collection, and disposal), industrial and manufacturing exports and imports, the value of innovative products, industrial employment in Uzbekistan and Kashkadarya Region, and investment in industrial sectors. Output, innovative products, and investment are expressed in billions of UZS in nominal terms, and foreign trade indicators in millions of USD.

2.2. Trend analysis

In his theory of trend observation, the Finnish scholar E. Lehtinen emphasises that the indicators used to monitor trends comprise macro-level measures appropriate to the level of analysis [17]. Research by J. Matos, C. Martins, and their colleagues also demonstrates the use of micro-level indicators in sector-wide trend observation [18]. In our view, the system of indicators selected for trend analysis is shaped by the scope within which changes in the object of analysis are examined from different perspectives.

The development trends of the indicators were described using trend lines fitted to the annual time series. Depending on the character of the dynamics, linear and second-order polynomial (parabolic) trend functions were used:

$$y_t = a_0 + a_1t \quad (1)$$

$$y_t = a_0 + a_1t + a_2t^2 \quad (2)$$

where y_t is the value of the indicator in year t , t is the time index, and a_0 , a_1 , and a_2 are the trend parameters.

2.3. Regression models

To examine the relationships between the trend indicators, regression models with a binary variable were estimated for innovative output, manufacturing imports, industrial output, and manufacturing employment (Table 1). The general form of the models is:

$$u = b_0 + b_1x + b_2D + e \quad (3)$$

where u is the endogenous variable, x is the explanatory factor, D is a binary variable (taking effect from 2020 in the models of innovative output and manufacturing imports, and from 2017 in the models of industrial output and manufacturing employment), b_0 , b_1 , and b_2 are model parameters, and e is the random error term. The statistical significance of the parameters was assessed using t -statistics and the corresponding p -values, the goodness of fit using the coefficient of determination (R^2), and the strength of the relationships using elasticity coefficients (ϵ).

3. Results

3.1. Industrial output

Manufacturing output followed a relatively smooth, monotonically increasing trend, with growth accelerating in recent years. Output increased from UZS 3,536.7 billion in 2015 to UZS 32,080.1 billion in 2024. The highest value over the period was recorded in 2024. The sector's development follows a standard parabolic trend line (Figure 1b).

Output in electricity, gas, steam, and air conditioning supply followed a relatively smooth, monotonically increasing trend, although growth slowed in recent years. Output rose from UZS 517.2 billion in 2015 to UZS 5,359.3 billion in 2024. The highest value over the period was UZS 5,431.5 billion, recorded in 2022. The sector's development follows a standard linear trend (Figure 1d).

Output in water supply, sewerage, waste collection, and disposal fluctuated in the early years, followed by relatively smooth, monotonic growth over the final three years, with growth accelerating towards the end of the period. Output increased from UZS 33.4 billion in 2015 to UZS 198.2 billion in 2024. The highest value was also recorded in 2024. The sector's development follows a standard linear trend (Figure 1e).

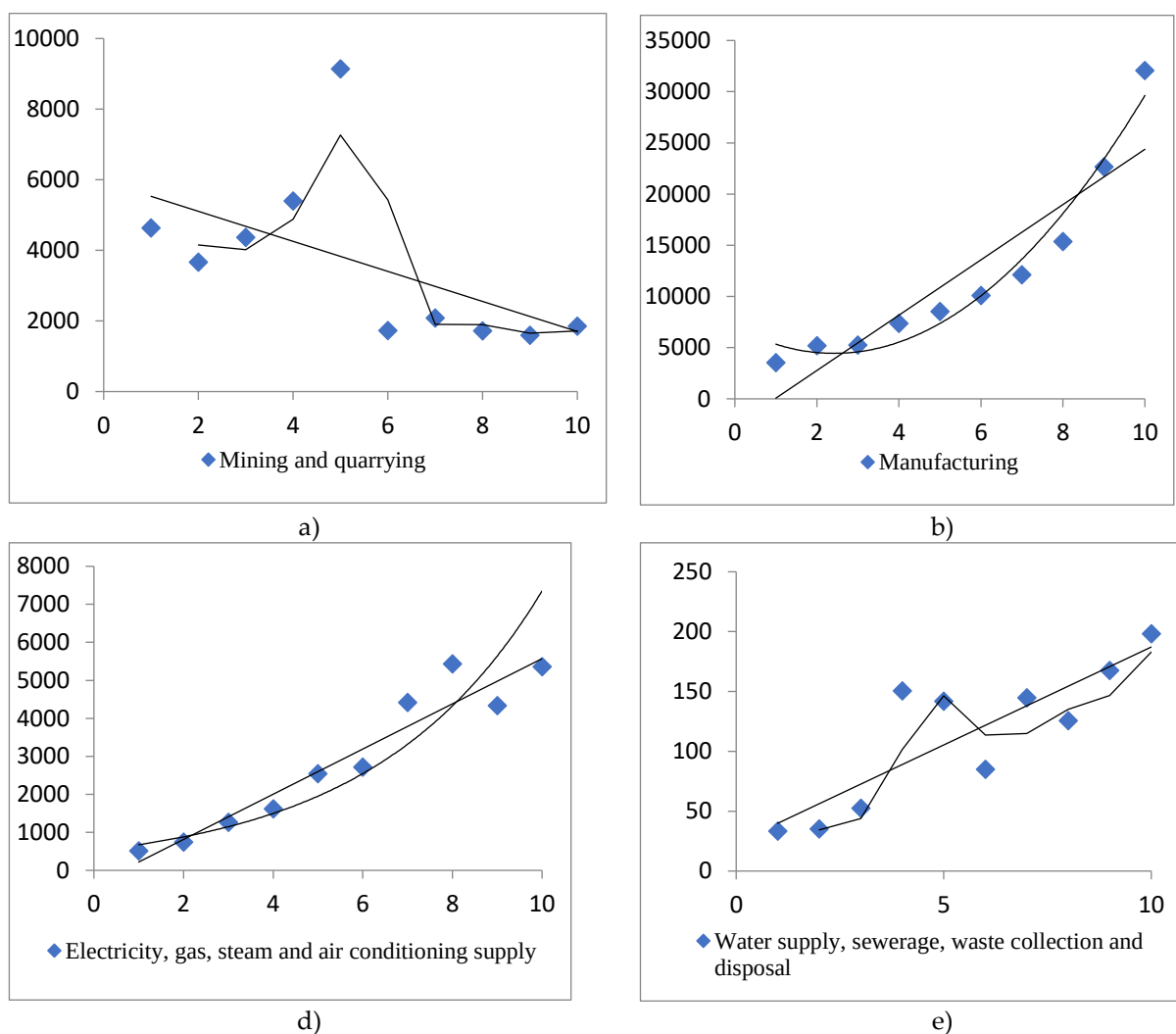


Figure 1. Trend Lines for Industrial Sectors in Kashkadarya Region

3.2. External trade

Industry plays an important role in Kashkadarya Region's external trade. Between 2015 and 2024, manufacturing accounted for an average of 48.8% of the region's exports. Industry's share of total exports increased from 31.7% in 2015 to 85.2% in 2024.

Manufacturing accounted for a substantial share of industrial exports. In 2015, manufacturing exports amounted to USD 95.76 million out of total industrial exports of USD 104.25 million, representing 80.3%. By 2024, manufacturing exports amounted to USD 265.26 million out of total industrial exports of USD 437.87 million, or 60.6% (Figure 2).

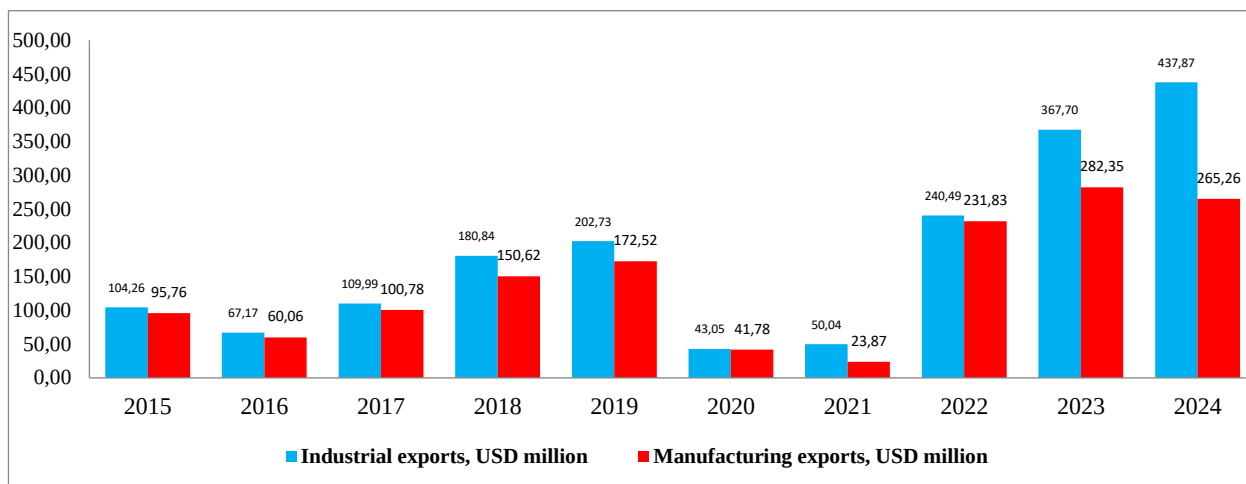


Figure 2. Industrial and Manufacturing Exports in Kashkadarya Region

This relative decline resulted from increases in the shares of mining and quarrying and of electricity, gas, steam, and air conditioning supply.

Industrial and manufacturing imports in Kashkadarya Region were very similar in value. In 2015, total imports of industrial products amounted to USD 441.81 million, while manufacturing imports reached USD 425.24 million. In 2024, these values were USD 588.53 million and USD 561.17 million, respectively. Over the period, manufactured products accounted for an average of 93.7% of industrial imports. Thus, manufactured products represented the principal component of the region's imports (Figure 3).

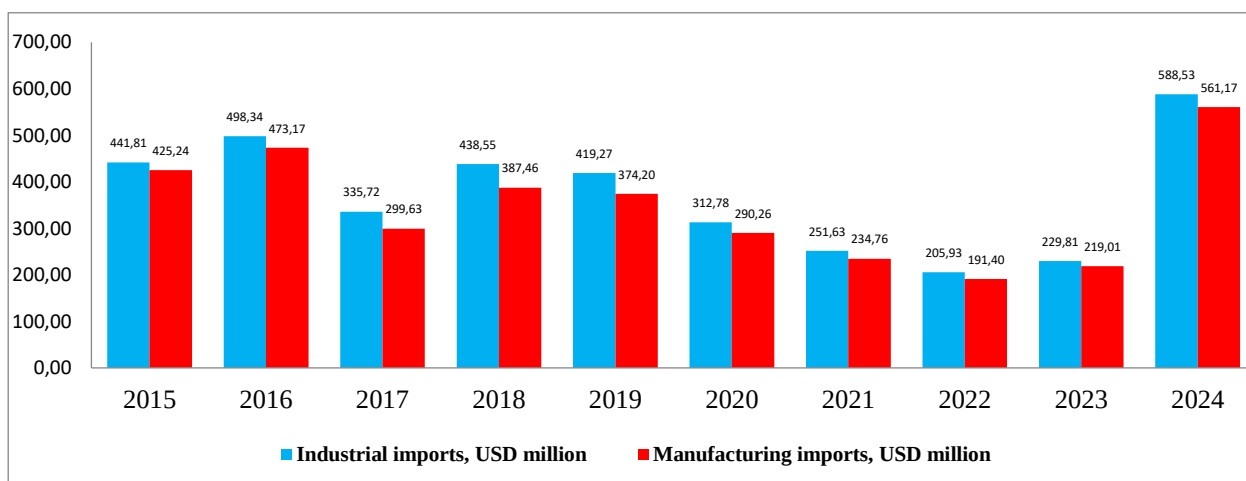


Figure 3. Industrial and Manufacturing Imports in Kashkadarya Region

Both industry as a whole and manufacturing recorded negative external trade balances in Kashkadarya Region. Positive balances occurred only in 2022–2023. The industrial trade balance reached its lowest point in 2016, at USD –431.17 million, and its highest point in 2023, at USD 137.88 million. The manufacturing trade balance closely followed the overall industrial balance, with its minimum and maximum occurring in the same years, at USD –413.11 billion and USD 63.34 billion, respectively. Overall, the volume of industrial imports into the region was largely determined by manufactured products. This dependence was even greater than the substantial manufacturing share observed in exports (Figure 4).

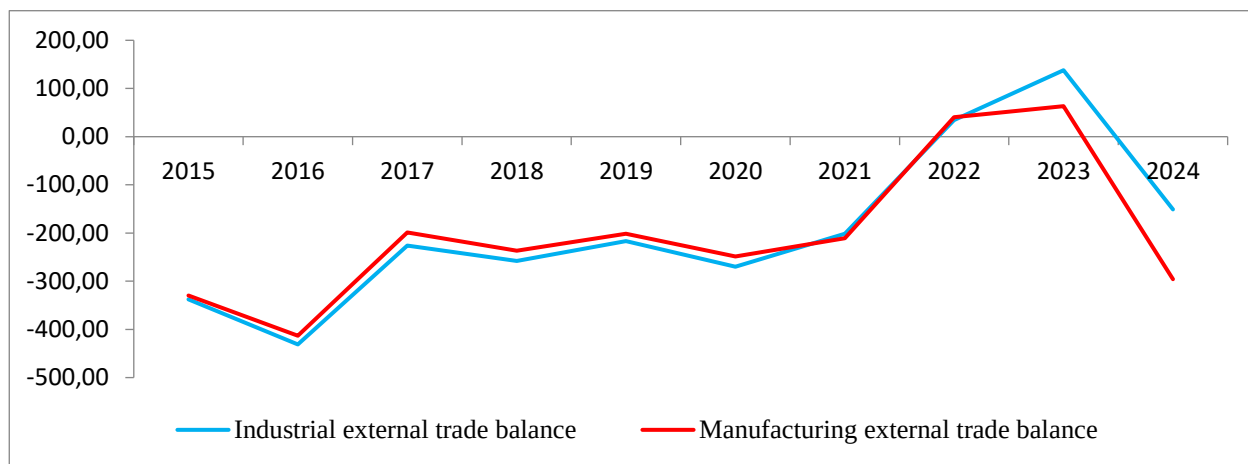


Figure 4. External Trade Balances of Industry and Manufacturing in Kashkadarya Region

3.3. Innovation, employment, and investment

The volume of innovative products in Kashkadarya's industry was primarily associated with the activities of manufacturing enterprises. According to the statistical data, innovative products currently account for an average of 17.25% of total output across industrial sectors, compared with 24.1% in manufacturing. Manufacturing can therefore be regarded as defining the innovation frontier within the industrial system. For this reason, we considered it appropriate to examine this indicator by manufacturing subsector.

The value of innovative products in Kashkadarya's manufacturing sector amounted to UZS 761.3 billion in 2015 and UZS 6,520.0 billion in 2024. This represents a nominal increase of UZS 5,758.7 billion. The textile industry recorded the highest growth.

Between 2015 and 2024, industrial employment increased by 91.8 thousand people in Uzbekistan and by 21.4 thousand in Kashkadarya Region. In percentage terms, these increases were 5.2% nationally and 13.8% regionally. Employment growth in the region was therefore considerably higher than the national rate.

A comparison of national and regional industrial employment levels over the past 15 years indicates that industrial employment in Kashkadarya consistently occupied the higher position, whereas the national level occupied the lower position. The trend in this ratio does not follow a standard trend pattern but instead fluctuates (Figure 5).

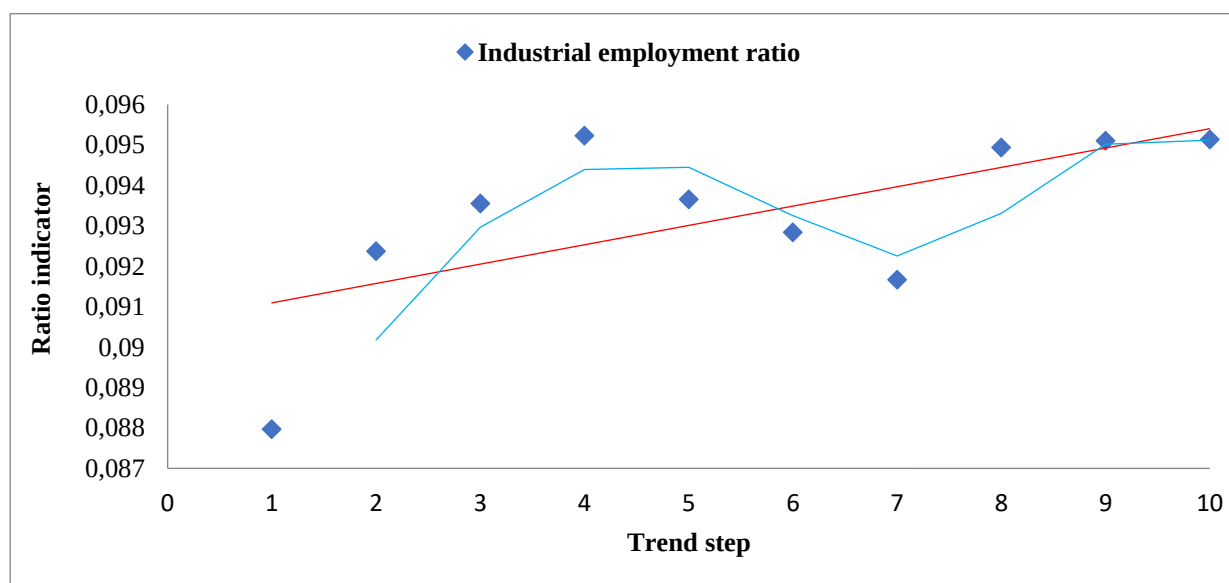


Figure 5. Positions of the Industrial Employment Ratio for Uzbekistan and Kashkadarya Region Along the Trend Axis

Investment dynamics varied across Kashkadarya's industrial sectors. Investment in mining and quarrying followed an unstable downward trend, whereas manufacturing and electricity, gas, steam, and air conditioning supply displayed accelerating growth. Investment in water supply, sewerage, waste collection, and disposal followed a constant trend. In particular, investment in mining and quarrying declined by UZS 609.2 billion in nominal terms between 2015 and 2024. The other sectors recorded nominal increases: UZS 11,815.9 billion in manufacturing; UZS 1,840.8 billion in electricity, gas, steam, and air conditioning supply; and UZS 70.2 billion in water supply, sewerage, waste collection, and disposal.

3.4. Regression models

The regression models estimated on the basis of the trend indicators are presented in Table 1.

Table 1. Regression Models Based on Trend Indicators for Industrial Sectors in Kashkadarya Region

Endogenous variable	Model	Explanatory factors
Innovative output (u_{11})	$u_{11} = 83.46 + 10.481 \times u_{12} + 1985.9 \times D_1$ $(t, p) (3.49, 0.008) (3.35, 0.011)$ $(3.58, 0.009)$ $R^2 = 0.91$ $\varepsilon u_{12} = 0.58$	Model assessing the effect of manufacturing export potential (u_{12}) on innovative output. D_1 is a binary variable.
Manufacturing imports (u_{21})	$u_{21} = 313.81 + 0.06 \times u_{11} - 245.55 \times D_2$ $(t, p) (5.82, 0.000) (2.33, 0.046)$ $(2.76, 0.028)$ $R^2 = 0.89$ $\varepsilon u_{11} = 0.44$	Model assessing the effect of innovative manufacturing output (u_{12}) on imports. D_2 is a binary variable.
Industrial output (u_{31})	$u_{31} = -391.11 + 2.53 \times u_{13} - 1633.1 \times D_3$ $(t, p) (3.75, 0.007) (16.3, 0.000)$ $(8.56, 0.000)$ $R^2 = 0.99$ $\varepsilon u_{13} = 0.75$	Model assessing the effect of industrial investment (u_{13}) on output. D_3 is a binary variable.
Manufacturing employment (u_{41})	$u_{41} = 109.89 + 14.68 \times u_{14} + 15.76 \times D_4$ $(t, p) (45.2, 0.000) (4.23, 0.004)$ $(8.42, 0.000)$ $R^2 = 0.92$ $\varepsilon u_{14} = 0.05$	Model assessing the effect of the manufacturing investment efficiency coefficient (u_{14}) on employment. D_4 is a binary variable.

4. Discussion

We consider the industrial development trends examined above to be relatively uncertain in character. During the selected period, the industrial economy did not experience sharply divergent policy shifts. Instead, its economic profile was shaped by inherently stable government programmes following a model of securing investment, optimising processes, and increasing income. Nevertheless, the outcomes varied in their degree of success and did not reach the expected levels. To clarify this uncertainty through the selected system of trend indicators, we examine the models developed in the course of the study and presented in Table 1.

The elasticity coefficient of the empirical function for innovative manufacturing output indicates that a 1% increase in manufacturing export potential leads to a 0.58%

increase in innovative output. The coefficient of the D_1 component further indicates that manufacturing exports have supported an increase in innovative output of UZS 1,985.9 billion. Expanding manufactured exports from the region thus emerges as an important factor in stimulating the growth of innovative products.

The elasticity coefficient of the empirical function for manufacturing imports indicates that a 1% increase in innovative manufacturing output leads to a 0.44% increase in imports of manufactured products. At the same time, growth in manufactured output supports a sustained decline in these imports of USD 245.55 million. This dual relationship suggests that innovative production in the manufacturing sector, which has developed and expanded through imported products, becomes a strong source of competition and simultaneously begins to substitute for imports. Accordingly, the increase in regional imports in recent years appears to be one of the requirements of innovative development. This relationship is medium-term in nature, indicating that greater attention to innovative manufacturing development is needed to maintain imports at a normal level.

There is an almost functional relationship between industrial output and investment in the sector: a 1% increase in investment produces a 0.75% increase in industrial output. However, the coefficient of the D_3 component, associated with the quality of this growth factor, indicates a sustained reduction in industrial output of UZS 1,633.1 billion as a response of production to investment practices. A clearly unidirectional effect of investment changes on industrial output should be observed when both display concurrent growth trends. Indeed, the relationship between industrial output and investment in the region reveals that their growth rates move in the same direction. At the same time, the component of the empirical investment function capturing qualitative changes points in the opposite direction. This suggests that investment mechanisms in Kashkadarya's industrial system operate only in one direction. Increasing investment is important, but the efficiency of its use also requires consideration. In this respect, the region is not currently achieving favourable performance in the relevant mechanisms. It is also possible that a substantial proportion of investment is being allocated to diversification, modernisation, intensification, the introduction of innovations, the development of workforce capabilities and intellectual resources, and other major areas of renewal. We therefore examine the empirical function linking employment to the investment efficiency coefficient in manufacturing, the region's largest industrial contributor.

An increase in sectoral employment primarily results from the expansion of the industrial system and the creation of jobs alongside export growth. In this case, development is the sole factor driving employment growth. On the one hand, the D_4 component indicates that this efficiency factor contributes to a continuing annual increase of 15,760 employees in the sector. On the other hand, the elasticity indicator shows a comparatively small contribution. This observed contradiction indicates a low level of investment utilisation in the region's industry. Developing the sector therefore requires a comprehensive approach that addresses the challenges of attracting investment together with the correction or introduction of mechanisms for its efficient use.

The results should be interpreted with caution. The analysis is based on a relatively short annual time series (2015–2024) and on nominal values, and the regression models are single-factor specifications with binary variables; therefore, the estimated coefficients reflect statistical associations between trend indicators rather than causal effects. In addition, aggregate trade data do not reveal the composition of imports, which limits the interpretation of the relationship between innovation and imports [4].

5. Conclusion

This study analysed the development trends and current state of the industrial sectors of Kashkadarya Region in 2015–2024 using a system of trend indicators covering production, foreign trade, innovation, employment, and investment. Manufacturing

output increased from UZS 3,536.7 billion to UZS 32,080.1 billion, and the value of innovative manufacturing products rose from UZS 761.3 billion to UZS 6,520.0 billion. Industrial employment in the region grew by 13.8%, compared with 5.2% nationally. At the same time, the external trade balances of industry and manufacturing remained negative in most years, with positive values recorded only in 2022–2023.

The regression models indicate that a 1% increase in manufacturing export potential is associated with a 0.58% increase in innovative output, a 1% increase in innovative manufacturing output with a 0.44% increase in imports of manufactured products, and a 1% increase in investment with a 0.75% increase in industrial output. However, the negative coefficient of the binary component in the output–investment model and the comparatively small elasticity of manufacturing employment with respect to the investment efficiency coefficient (0.05) point to a low level of investment utilisation in the region's industry.

These findings suggest that regional industrial policy should combine the attraction of investment with mechanisms that improve the efficiency of its use, support the expansion of manufactured exports as a driver of innovative production, and promote innovative manufacturing capable of substituting for imports. Future research should extend the analysis to subsector- and firm-level data, use real (inflation-adjusted) values, and apply multivariate models to distinguish the effects of investment, innovation, and trade on regional industrial development.

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