

Article

Systematic Assessment of Regional Economic Potential for Innovation-Driven Industrial Development

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Abstract: This study systematically assesses the economic potential of administrative areas for innovation-driven industrial development in Kashkadarya Region, Uzbekistan. Six indicators, averaged over 2022–2024, are used to evaluate 16 cities and districts. Ward's hierarchical clustering and composite indices identify territorial groups and classify them into four development zones. Kasbi District occupies the highest zone, while Dehqonobod, Nishon, Kokdala, and Chiroqchi districts fall within the lowest zone. Empirical models examine innovative production in relation to capital-labour intensity ratios and technological development. The findings reveal differences in investment utilisation and innovation infrastructure, indicating a need for targeted reforms, particularly in the lowest zone, which accounts for 33% of regional industrial production. Beyond the territorial classification, the study interprets zone-specific empirical relationships between innovative production, the capital-to-labour intensity ratio, and technological development. The contribution of the analysis lies in combining hierarchical clustering, composite indicators, and empirical functions within a unified framework for territorial diagnosis. The resulting evidence can support differentiated regional policy by identifying where innovation infrastructure, investment efficiency, workforce productivity, and technology upgrading require the greatest attention.

Keywords: regional economic potential, industrial innovation, composite index, Ward's clustering, investment efficiency, Kashkadarya Region.

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1. Introduction

Innovation-driven development of industrial sectors in a region is directly related to the economic potential of its administrative areas. In-depth examination and systematic assessment of the distinctive economic opportunities of each area play an important role in this development process.

Regional economic potential is multidimensional: it reflects not only the scale of production but also the capacity of a territory to transform investment, labour, knowledge, and infrastructure into higher-value and innovative output. Composite-indicator methodology is particularly useful in this setting because it allows heterogeneous measures to be interpreted within a common analytical framework while preserving the need for careful normalization, aggregation, and sensitivity analysis [1]. In a regional industrial context, this distinction is important because a district with a large production

base does not necessarily possess the strongest innovation potential if investment productivity, value-added capacity, or innovation output per employee remain weak.

The need for a systematic assessment of the economic potential of administrative areas arises from the need to examine resource allocation, intersectoral linkages, the foundations for attracting investment, the early identification of regional problems, and competitiveness when defining development goals and tasks. In particular, Pan and Guo regard the identification of regional economic potential for innovative development as an assessment of a region's capacity to absorb innovation [2].

Assessing the economic potential of administrative areas is important for evaluating the development of innovation infrastructure, stronger integration between industrial sectors, regional specialisation, sustainable economic development, and digital transformation. Systematic assessment provides a means of identifying regional levels of innovative development, the conditions for balancing production and innovation infrastructure, the extent of intersectoral and interregional integration, and the foundations for directing investment flows effectively. Its results can support scientific conclusions and practical proposals for improving regional industrial development strategies, establishing criteria for efficient resource use, deepening public-private cooperation and integration into regional and global networks, and improving existing economic mechanisms [3].

Accordingly, the objective of this study is to develop a systematic territorial assessment of innovation-driven industrial development in Kashkadarya Region by combining multivariate grouping, composite measurement, and zone-specific empirical modeling. The analysis addresses three interrelated questions: how the administrative areas differ in the structure of their innovation potential; how those differences can be converted into operational development zones; and how the relationship between capital intensity, labour intensity, and technological development varies across the resulting zones. This integrated design is intended to move beyond a simple ranking and toward an explanation of why territories occupy different development positions.

1.1 Literature Review

Pan and Guo [2] examine innovation systems through knowledge transfer and the triple helix framework. They treat research institutions as distinct innovation units and relate system efficiency to collaboration, spatial relationships, knowledge accumulation, and local resource constraints. This perspective is relevant to territorial assessment because innovative development depends on the relationships through which regional resources are mobilised, as well as on the resources themselves.

Composite indicators provide a means of bringing different dimensions of regional potential into a common framework. The handbook prepared by the OECD, the European Union, and the European Commission's Joint Research Centre [1] explains the methodological complexity of constructing indicators used to compare performance in fields including innovation and industrial competitiveness. It provides technical guidance intended to improve the quality of such measures. For the present study, this literature supports treating the construction and interpretation of an integrated index as a methodological task in its own right, rather than regarding a ranking as a complete explanation of regional development.

Hierarchical classification offers a complementary approach to comparing administrative areas. Ward [4] presents a grouping procedure that successively combines subsets according to a specified objective function, producing a hierarchy of groups whose members are similar in the selected characteristics. This provides the methodological foundation for identifying territorial groups in the present study. Clustering and composite indices serve different purposes: the former identifies similarity between areas, while the latter summarises their positions against a set of indicators. Their combined use is therefore relevant to the article's distinction between territorial groups and levels of innovative industrial development.

The reviewed sources show that the principal criteria and indicator systems for assessing regional innovation potential have been examined in numerous studies. However, the integrated results of these indicator systems have been largely confined to explaining ranking positions. Moreover, levels of innovative development have often been linked to numerous general or external indicators, increasing the number of elements in the system. The participation of such additional elements in the calculations can affect the quality of these methodological approaches.

The broader regional-econometric literature also demonstrates the usefulness of combining forecasting, efficiency analysis, and cluster-based approaches when territorial systems contain heterogeneous economic structures. Studies associated with public-service forecasting, industrial-enterprise efficiency, innovative activity in trade, retail-system methodology, agricultural clustering, agrocluster optimization, small-business sustainability, and sector-specific econometric modeling provide complementary examples of how quantitative methods can be adapted to regional decision problems [5]–[13]. Although these studies address different sectors, together they reinforce the methodological argument that territorial development should be evaluated through several interacting dimensions rather than through a single output indicator.

The present study extends this line of inquiry by treating clustering and composite indexing as complementary rather than interchangeable tools. Cluster analysis identifies similarity in the multivariate indicator space, whereas the composite index places each territory relative to development benchmarks. The subsequent empirical modeling then adds an explanatory layer by examining how the balance between capital and labour intensity is associated with innovative production within each development zone. This sequence provides a transparent bridge from measurement to classification and from classification to policy interpretation.

2. Materials and Methods

2.1 Indicators and Administrative Areas

On this basis, the following indicators were selected for the analysis:

The empirical design is a comparative territorial assessment based on average indicator values for 2022–2024. Using multi-year averages reduces the influence of one-year volatility and allows the analysis to emphasize structural differences among the 16 administrative areas. At the same time, the interpretation is deliberately cross-territorial: the averaged indicators describe relative economic and innovation positions over the observation window and should not be read as a causal estimate of how a change in one indicator mechanically produces a change in another.

X_1 – industrial output, UZS billion;

X_2 – innovation output in industrial sectors, UZS billion;

X_3 – workforce potential in industrial sectors, percent;

X_4 – capacity to generate high added value in industrial sectors, UZS billion;

X_5 – innovative output per unit of investment, expressed as a ratio;

X_6 – innovative industrial output per employee, UZS million.

The administrative areas of Kashkadarya Region are designated as follows:

For clarity under IEEE citation style, the bracketed numbers [1]–[16] used in the territorial coding below are administrative-area identifiers for the cluster analysis and are not bibliographic reference citations.

[1] Qarshi City; [2] Shahrisabz City; [3] Guzor District; [4] Dehqonobod District; [5] Qarshi District; [6] Qamashi District; [7] Koson District; [8] Kitob District; [9] Mirishkor District; [10] Muborak District; [11] Nishon District; [12] Kasbi District; [13] Kokdala District; [14] Chiroqchi District; [15] Shahrisabz District; [16] Yakkabog District. The data for these indicators are based on average values for 2022–2024 (Table 1).

2.2 Hierarchical Grouping and Composite Indicators

At the next stage, the areas are grouped using Ward's hierarchical method, with metric proximity based on squared Euclidean distance. The resulting groups are presented in Figure 1.

Ward's procedure is appropriate for this task because each merger is selected to minimize the increase in within-cluster dispersion. Combined with squared Euclidean distance, the method produces compact groups of territories that are internally similar with respect to the selected indicators. The dendrogram therefore provides a structural view of territorial similarity, while the later composite-index procedure is used to distinguish the development level of those territories. This distinction helps avoid interpreting cluster membership itself as a direct measure of superiority or inferiority.

The composite indicator, or aggregate index, based on the innovation potential indices of Kashkadarya's administrative areas is expressed as follows:

$$IK_{X(i)}^{(j)} = \sqrt[n]{\prod_{i=1}^n \omega_{ji}}, j = 1.2, \dots, m_1 \quad (1)$$

Here, $IK_{X(i)}^{(j)}$ is the composite indicator of innovation potential for the industrial system of area j ; ω_{ji} is the growth rate of indicator i in area j ; n is the number of indicators; and m_1 is the number of areas.

The composite indicator of innovation potential calculated for the districts and cities of Kashkadarya Region determines the level of innovation potential of their industrial systems. It can be used to assess which areas have innovatively developed industries and which are experiencing slower innovative development. Such an assessment requires benchmark values. These benchmarks are determined by the composite indicators of the groups formed using the specified territorial measures. The group indicators are calculated as follows:

The benchmark approach also has a practical advantage for regional management. Rather than relying only on a rank order, the procedure converts the multivariate information into development zones that can be linked to differentiated policy responses. The highest and intermediate zones can be evaluated in terms of consolidation and diffusion of existing innovative capacity, while the lowest zone can be examined for constraints in investment allocation, workforce productivity, and technological modernization.

$$IK_{G(s)}^{(s)} = \sqrt[n]{\prod_{i=1}^n \sqrt[n_s]{\prod_{p \in G_s} \omega_{pi}}}, s = 1.2, \dots, m_2, p \leq n \quad (2)$$

Here, $IK_{G(s)}^{(s)}$ is the composite indicator of innovation potential for the industrial system of territorial group s ; G_s is group s ; ω_{pi} is the growth rate of indicator i in area p ; n is the number of indicators; n_s is the number of areas belonging to G_s ; p denotes the order of areas belonging to G_s ; and m_2 is the number of groups.

2.3 Factors Affecting Innovative Production

Factors affecting innovation potential in manufacturing are examined across the four zones classified by their levels of innovative development. This classification is based on the elements of the X set described above, which represent indicators at the highest level of the classification. Middle- and lower-level indicators do not affect classification directly but act as latent factors shaping group composition. Identifying the factors that influence these elements helps explain the underlying reasons for the position of areas in the lowest zone.

For the areas belonging to each category, innovative production $X_2^{(Z)}$ is assessed by zone in relation to industrial output per unit of investment, $u_{1(z)}$; industrial output per worker, $u_{2(z)}$; and the technological development component, $e^{w_z(t)}$.

As in other sectors, industrial production is closely related to labour and capital as its principal resources. However, changes in the volume of innovation within industrial output cannot be assessed simultaneously through changes in the efficiency of both capital

and labour across the zones, because these factors cannot be included together in a single model. Ratios of capital intensity to labour intensity are therefore used.

A high value of this measure of the efficiency of capital use relative to labour indicates that capital plays a greater role in industrial production: production is capital-intensive and depends primarily on technology and automation. Low values indicate that labour plays a more important role and that labour-intensive activities predominate. Intermediate values represent the most favourable situation, reflecting a balanced production process.

The zone-specific empirical functions are interpreted as associative models of innovative production. Their elasticity coefficients show how sensitively innovative output changes with the modeled capital-to-labour intensity relationship within each zone, while the reported t-statistics, p-values, Durbin–Watson statistics, and information criteria provide evidence on statistical significance and model fit. Because the specification is not an experimental or quasi-experimental design, the estimated elasticities are interpreted as conditional empirical relationships rather than causal effects.

3. Results

3.1 Innovation Potential and Territorial Groups

Table 1. Innovation Potential Indicators for the Administrative Areas of Kashkadarya Region

Cities and districts	Indicators					
	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆
Qarshi City	4088.877	1310.548	36.890	982.911	0.605	176.169
Shahrisabz City	547.080	166.896	29.330	115.158	0.573	142.841
Guzor District	3940.211	831.509	40.530	654.480	0.358	172.892
Dehqonobod District	1109.851	115.812	12.940	68.511	0.184	159.691
Qarshi District	765.643	205.761	28.350	133.992	0.497	154.988
Qamashi District	2149.241	561.679	24.780	329.706	0.448	181.065
Koson District	1260.495	311.713	30.350	209.315	0.448	150.958
Kitob District	1236.400	343.588	29.260	205.809	0.536	163.329
Mirishkor District	731.486	162.290	27.330	80.983	0.375	164.379
Muborak District	883.478	182.354	30.570	120.171	0.361	164.215
Nishon District	7686.219	1587.410	21.480	954.652	0.376	163.120
Kasbi District	1879.768	445.906	23.790	247.433	0.416	164.459
Kokdala District	189.066	39.581	22.810	15.793	0.371	98.987
Chiroqchi District	765.734	147.049	24.320	87.957	0.354	175.225
Shahrisabz District	670.220	198.027	20.450	119.193	0.514	170.107
Yakkabog District	944.641	238.212	28.840	164.698	0.495	157.703

An initial quantitative comparison of the innovation potential indicators suggests that Qarshi City performs favourably across all indicators. The same can be said of Guzor District. Dehqonobod, Mirishkor, and Kokdala districts stand out for their lowest indicator values. Grouping the areas according to the relative magnitudes of the initial variables yields three groups:

The raw indicators reveal an important scale-versus-efficiency distinction. Nishon District records the largest industrial output and innovation output among the listed territories, yet it is later classified in the lowest innovation-development zone. Conversely, Kasbi District does not dominate the table in absolute production scale but occupies the

highest development zone after the composite assessment. This contrast indicates that the classification is not driven by output volume alone; the balance among the six dimensions materially affects the territorial position.

Group 1: Qarshi City and Guzor District.

Group 2: Dehqonobod, Mirishkor, and Kokdala districts.

Group 3: All areas not included in Groups 1 and 2.

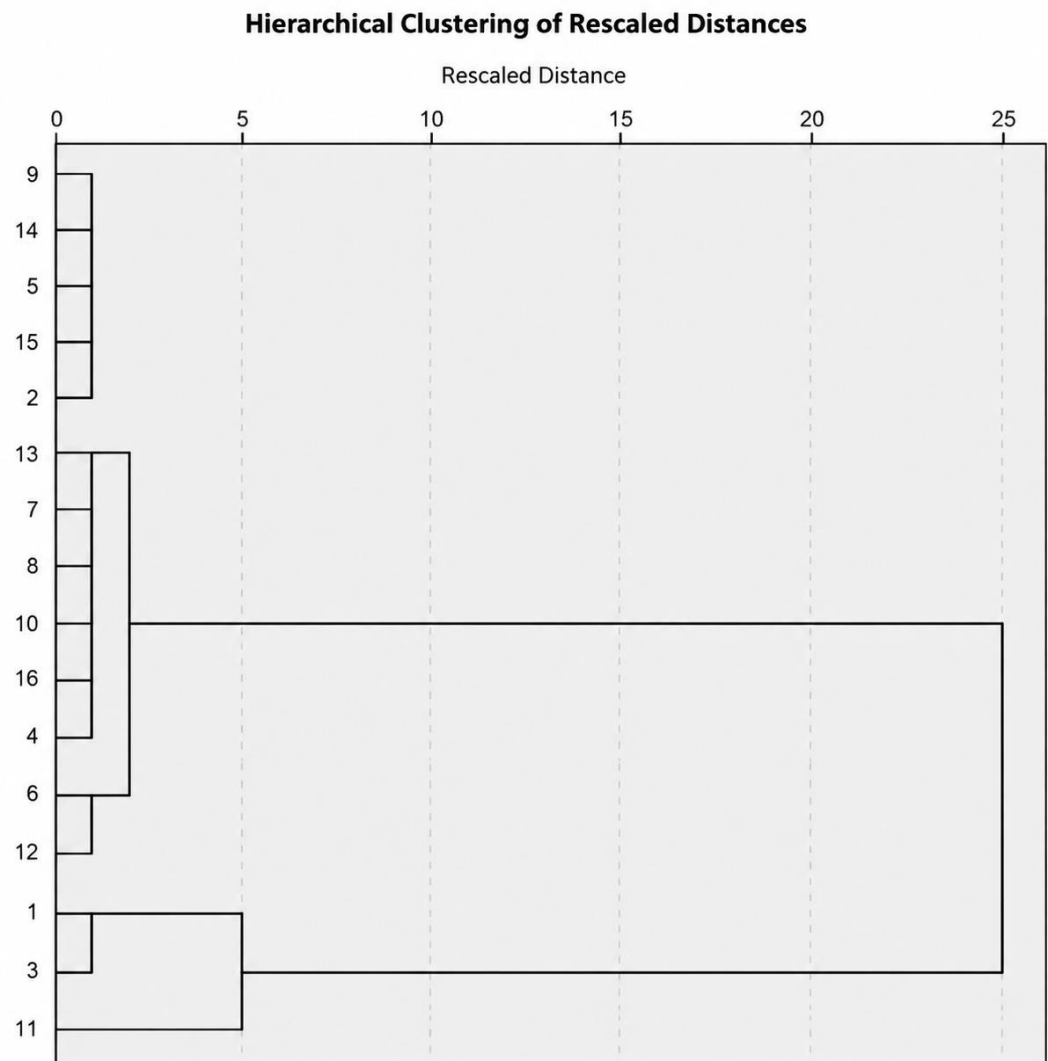


Figure 1. Dendrogram Constructed Using Ward's Method

Group 1: [2] Shahrisabz City; [4] Dehqonobod District; [5] Qarshi District; [7] Koson District; [8] Kitob District; [9] Mirishkor District; [10] Muborak District; [13] Kokdala District; [14] Chiroqchi District; [15] Shahrisabz District; [16] Yakkabog District.

Group 2: [6] Qamashi District and [12] Kasbi District.

Group 3: [1] Qarshi City; [3] Guzor District; [11] Nishon District.

The dendrogram-based grouping differs from the initial descriptive grouping based on the relative magnitudes of the raw variables. That difference is analytically meaningful: the hierarchical procedure evaluates joint multivariate proximity rather than isolated high or low values. Qamashi and Kasbi form a distinct pair, while Qarshi City, Guzor, and Nishon form another group, showing that territories can be similar in their overall indicator profiles even when they differ substantially on individual measures.

3.2 Composite Indicators and Development Zones

Equation (2) is used to calculate the composite innovation potential indicator for the industrial systems of the groups formed by Kashkadarya's administrative areas (Table 2).

Table 2. Composite Innovation Potential Indicators for Groups of Administrative Areas in Kashkadarya Region

Cities and districts	s	Indicators (index)						$IK_{G(s)}^{(s)}$
		ω_{s1}	ω_{s2}	ω_{s3}	ω_{s4}	ω_{s5}	ω_{s6}	
Group 1	1	101.55	106.92	106.20	107.21	107.35	108.22	106.22
Group 2	2	106.01	117.38	108.38	110.96	111.03	114.94	111.39
Group 3	3	102.59	108.64	107.98	108.11	105.44	112.84	107.55

The composite indicators calculated for the territorial groups serve as benchmarks for identifying areas with high, intermediate, or slow innovative industrial development.

The calculated benchmark indicators divide the region's administrative areas into four zones and categories according to the level of innovative industrial development. The highly developed category comprises Zone 1, defined by $IK \geq 111.39$; the active intermediate category comprises Zone 2, defined by $107.55 \leq IK < 111.39$; the passive intermediate category comprises Zone 3, defined by $106.22 \leq IK < 107.55$; and the lower category comprises Zone 4, defined by $IK < 106.22$.

The areas' composite indicators are compared against these benchmarks. The assessment places Dehqonobod, Nishon, Kokdala, and Chiroqchi districts in the lowest zone of innovative industrial development. Shahrisabz City and Guzor, Mirishkor, Muborak, Shahrisabz, and Yakkabog districts fall within the passive intermediate zone. Qarshi City and Qamashi, Qarshi, Koson, and Kitob districts belong to the active intermediate zone, while Kasbi District occupies the highest zone.

The four-zone result provides a more policy-oriented interpretation than the cluster solution alone. Zone membership identifies not only similarity but also relative development position. The lowest-zone classification of Dehqonobod, Nishon, Kokdala, and Chiroqchi suggests that interventions should be tailored to the specific combination of weak innovation efficiency, value-added capacity, workforce potential, or technological conditions observed in those areas rather than applying a uniform regional program.

3.3 Correlations and Empirical Models

The correlation matrix shows strong positive relationships between the indicators in all industrial zones (Table 3).

Across the four zones, the reported pairwise correlations range from 0.81 to 0.99, indicating strong positive co-movement among the modeled innovation and production-efficiency indicators. The strength of these relationships supports the decision to interpret capital intensity, labour intensity, and technological development jointly; however, high correlation also reinforces the need for caution when attributing independent causal effects to closely related production factors.

Table 3. Correlation Coefficients for Innovation and Production Efficiency Indicators Across Industrial Development Zones

	Industrial Zone 1			Industrial Zone 2			Industrial Zone 3			Industrial Zone 4		
	$X_2^{(Z)}$	$u_{1(z)}$	$u_{2(z)}$	$X_2^{(Z)}$	$u_{1(z)}$	$u_{2(z)}$	$X_2^{(Z)}$	$u_{1(z)}$	$u_{2(z)}$	$X_2^{(Z)}$	$u_{1(z)}$	$u_{2(z)}$
$X_2^{(Z)}$	1	-	-	1	-	-	1	-	-	1.00	-	-
$u_{1(z)}$	0.93	1	-	0.96	1	-	0.86	1	-	0.91	1.00	-
$u_{2(z)}$	0.93	0.96	1	0.99	0.95	1	0.81	0.84	1	0.98	0.92	1.00

Observations of the region's industrial zones over the past 15 years suggest that, where labour efficiency is being achieved, capital intensity may be declining. In fact, efficiency may be high in both respects. Overall, the dynamics of the ratio of capital

intensity to labour intensity in Kashkadarya's industrial sectors are consistent with one of two situations:

Situation 1: High labour intensity and relatively low capital intensity, corresponding to an intermediate level of technological development.

Situation 2: Intermediate labour intensity and very low capital intensity, corresponding to a low level of technological development.

To clarify this situation, the following multiplicative power models were developed, as presented in Appendices 1–4:

For Industrial Zone 1

$$X_2^{(1)} = 5.163 \cdot t^2 + 1062.74 \cdot \frac{u_{11}}{u_{21}} - 576.24, R^2 = 0.94, \sigma = 2.2\% \quad (3)$$

(t;p): (9.9; <0.01) (4.56; <0.01) (-5.17; <0.01)

For Industrial Zone 2

$$X_2^{(2)} = 17.387 \cdot t^2 + 2009.93 \cdot \frac{u_{12}}{u_{22}} - 929.51, R^2 = 0.97, \sigma = 1.5\% \quad (4)$$

(t;p): (11.1; <0.01) (2.90; 0.01) (-3.04; 0.01)

For Industrial Zone 3

$$X_2^{(3)} = 23.79 \cdot t + 2517.49 \cdot \frac{u_{13}}{u_{23}} - 1591.01, R^2 = 0.80, \sigma = 11.9\% \quad (5)$$

(t;p): (6.35; <0.01) (3.3; <0.01) (-2.54; 0.026)

For Industrial Zone 4

$$X_2^{(4)} = 245.97 \cdot t + 2997.18 \cdot \frac{u_{14}}{u_{24}} - 2741.26, R^2 = 0.92, \sigma = 4.1\% \quad (6)$$

(t;p): (7.54; <0.01) (5.16; <0.01) (-5.81; <0.01)

Here, t denotes the trend step, and σ is the model's absolute relative error. The goodness-of-fit statistics for these models are presented in Table 4.

The goodness-of-fit statistics in Table 4 complement the coefficient-level significance tests. The F-statistics indicate that the empirical functions are jointly informative, while Durbin–Watson values close to two in Zones 1 and 2 suggest comparatively limited first-order residual autocorrelation. AIC, BIC, and HQC are reported as model-selection diagnostics and are most useful when comparing alternative specifications estimated on the same data. Their inclusion strengthens the reproducibility of the model-evaluation stage without changing the substantive zone classifications.

Table 4. Goodness of Fit of the Empirical Functions for Innovative Production Across Industrial Zones

Model fit statistics				
F	DW	AIC	BIC	HQC
Empirical function for Industrial Zone 1				
100.0363	1.983506	11.27197	11.41358	11.27046
Empirical function for Industrial Zone 2				
175.9321	1.922158	11.59701	11.73862	11.59550
Empirical function for Industrial Zone 3				
23.08203	1.554013	13.48002	13.62163	13.47852
Empirical function for Industrial Zone 4				
71.77051	1.655882	12.71103	12.85264	12.70952

4. Discussion

In Industrial Zone 1, innovative growth driven by technological progress requires relatively short periods, as the time parameter follows a parabolic trend in the model. According to the elasticity coefficient of Equation (3) (see Table 4), a 1% increase in the

ratio of capital intensity to labour intensity leads to a 0.72% increase in innovative production. The capital–labour ratio has a stronger positive effect on innovative production in this zone. Investment is used efficiently in the areas comprising the zone, and their innovation infrastructure is relatively well developed.

In Industrial Zone 2, innovative growth driven by technological progress also requires relatively short periods, as the time parameter follows a parabolic trend. According to the elasticity coefficient of Equation (4) (see Table 4), a 1% increase in the ratio of capital intensity to labour intensity leads to a 0.68% increase in innovative production. The balance between capital investment and labour productivity substantially stimulates innovative development in this zone.

In Industrial Zone 3, innovative growth driven by technological progress requires relatively long periods, as the time parameter follows a linear trend. According to the elasticity coefficient of Equation (5) (see Table 4), a 1% increase in the ratio of capital intensity to labour intensity leads to a 0.55% increase in innovative production. Investment and labour productivity have a moderate effect on innovative production in this zone. This indicates that investment is directed more towards improving labour productivity and resolving organisational problems.

In Industrial Zone 4, innovative growth driven by technological progress requires relatively long periods, as the time parameter follows a linear trend. According to the elasticity coefficient of Equation (6) (see Table 4), a 1% increase in the ratio of capital intensity to labour intensity leads to a 0.38% increase in innovative production. Investment and labour productivity do not substantially affect innovative production in this zone. This indicates that investment is insufficiently directed towards innovation and that labour productivity is low. Since Industrial Zone 4 comprises four areas accounting for 33% of the region's industrial production, these findings indicate a need for broad-based reforms in Kashkadarya's industrial system.

Taken together, the elasticity estimates display a clear cross-zone gradient: 0.72 in Zone 1, 0.68 in Zone 2, 0.55 in Zone 3, and 0.38 in Zone 4. This pattern suggests that the same improvement in the capital-to-labour intensity relationship is associated with progressively smaller innovation gains as the underlying territorial innovation environment weakens. A plausible interpretation is that physical investment produces stronger innovation outcomes when complementary institutions, skills, technology absorption, and innovation infrastructure are already functioning effectively. In the weaker zones, capital deepening alone may therefore be insufficient unless it is combined with organizational and human-capital improvements.

From a regional-policy perspective, the results support differentiated intervention. Zone 1 should focus on sustaining technology diffusion, research–industry linkages, and high-value investment. Zone 2 requires policies that preserve the relatively strong capital–labour balance while improving the commercialization of innovation. Zone 3 would benefit from measures that connect investment more directly to technological renewal and workforce upgrading. Zone 4 requires the most comprehensive package, including better targeting of investment toward innovation, modernization of production assets, development of innovation-support infrastructure, and productivity-oriented training. Because the four lowest-zone areas account for 33% of regional industrial production, improvements in this group have region-wide significance rather than merely local importance.

The findings should also be interpreted within the study's methodological limits. First, the territorial indicators are averaged over 2022–2024, so short-run shocks and year-specific changes are intentionally smoothed. Second, composite indicators and hierarchical clusters can be sensitive to indicator selection, scaling, weighting, and benchmark rules. Third, the empirical functions describe statistical associations within development zones and do not establish causal effects. Future research can strengthen the framework by testing alternative normalization and weighting schemes, applying cluster-stability

checks, incorporating longer panel data, and evaluating whether spatial spillovers between neighboring districts affect innovation performance.

5. Conclusion

This study provides a systematic assessment of the economic potential of Kashkadarya Region's administrative areas for innovation-driven industrial development. By combining six territorial indicators, Ward's hierarchical clustering, composite innovation-potential indices, and zone-specific empirical models, the analysis distinguishes similarity among territories from their relative development level. The results identify Kasbi District as the highest-zone territory and Dehqonobod, Nishon, Kokdala, and Chiroqchi as the lowest-zone territories, while the empirical models show a declining innovation elasticity from the strongest to the weakest development zones.

The central implication is that regional innovation policy should not be based on industrial scale alone. Balanced use of investment and labour, technology absorption, value-added capacity, and innovation infrastructure jointly determine whether industrial resources are converted into innovative output. The proposed zoning framework therefore offers a practical basis for prioritizing reforms, differentiating investment support, and monitoring progress across administrative areas. Its future application will be strongest when combined with sensitivity analysis, longer time-series or panel data, and explicit evaluation of spatial and institutional factors.

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