



CENTRAL ASIAN JOURNAL OF INNOVATIONS ON TOURISM MANAGEMENT AND FINANCE



<https://cajitm.centralasianstudies.org/index.php/CAJITMF>

Volume: 07 Issue: 04 | October 2026 ISSN: 2660-454X

Article

An Integrated Methodological Framework for Assessing Agglomeration Efficiency and Economic Potential Utilization

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Abstract: The study develops an integrated methodological framework for assessing agglomeration efficiency and its role in transforming regional economic potential into measurable economic outcomes across Uzbekistan. The proposed approach integrates economic concentration, productive capacity, infrastructure connectivity, labor-market integration, investment intensity, and resource-use efficiency into a multidimensional assessment framework. It enables the identification of spatial heterogeneity in agglomeration performance and evaluates differences between available economic potential and its effective utilization. The framework provides an empirical basis for regional classification, detection of agglomeration efficiency gaps, and formulation of evidence-based mechanisms for more efficient utilization of territorial economic potential.

Keywords: agglomeration efficiency, economic potential utilization, integrated assessment, regional economics, spatial concentration, regional disparities, economic efficiency, territorial development, spatial heterogeneity, Uzbekistan

Citation: Olimjanov, I. O. An Integrated Methodological Framework for Assessing Agglomeration Efficiency and Economic Potential Utilization. Central Asian Journal of Innovations on Tourism Management and Finance 2026, 515-526.

Received: 14th Aug 2026

Revised: 28th Aug 2026

Accepted: 11th Sept 2026

Published: 30th Sept 2026



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1. Introduction

The increasing spatial concentration of production factors, labor resources, capital, infrastructure, and innovation activities has become one of the fundamental patterns shaping contemporary regional economic development. Under conditions of accelerating urbanization and intensifying interregional competition, agglomeration processes can no longer be interpreted merely as the concentration of population and economic activity within large urban centers. Instead, they represent a complex spatial-economic mechanism through which territorial resources, productive capacities, labor-market advantages, infrastructure connectivity, and market potential can be transformed into higher productivity and measurable economic outcomes. According to the United Nations Human Settlements Programme (UN-Habitat), cities generate more than 70 percent of global gross domestic product, demonstrating the increasing role of spatial concentration and urban economic systems in shaping national and regional competitiveness [1].

The economic significance of agglomeration is primarily associated with positive externalities generated by the spatial proximity of firms, workers, consumers, infrastructure, and institutions. Geographic concentration can facilitate labor-market pooling, specialization, knowledge diffusion, technological spillovers, supplier–producer linkages, market accessibility, and reductions in transaction and transportation costs. OECD evidence indicates that metropolitan areas tend to demonstrate substantial productivity and income advantages compared with non-metropolitan territories. Across OECD countries, GDP per capita in metropolitan regions has been reported to be, on average, approximately 32 percent higher than in other regions. Nevertheless, excessive spatial concentration may simultaneously generate agglomeration diseconomies, including congestion, increasing housing and land costs, environmental pressures, infrastructure overload, and widening intra-regional inequalities [2]. Consequently, the economic effects of agglomeration should be assessed not only through the scale of spatial concentration but also through the efficiency with which such concentration converts available territorial resources into sustainable economic outcomes.

This distinction has important methodological implications. A high level of urbanization, population density, or concentration of enterprises does not necessarily imply efficient utilization of regional economic potential. From the perspective of contemporary regional economics, the key analytical question is therefore not whether agglomeration exists, but to what extent agglomeration mechanisms enable a region to transform its available economic potential into actual economic performance. Recent OECD approaches to regional development increasingly emphasize place-based policies that mobilize territorially specific assets, institutional capacities, infrastructure, human resources, and local comparative advantages [3]. Within this conceptual framework, an integrated assessment of agglomeration efficiency becomes essential for identifying the gap between the economic potential available within a region and the actual results generated through its utilization.

This issue is particularly relevant for Uzbekistan, where rapid urbanization, structural economic transformation, population growth, and the increasing concentration of economic activity around major urban centers are reshaping the spatial organization of the national economy. According to the World Bank, more than half of Uzbekistan's population resides in urban areas, while accelerating urban growth is creating increasing pressures on land use, transport systems, engineering infrastructure, housing, and public-service provision. At the same time, limitations in spatial and infrastructure-related information may constrain evidence-based territorial planning, investment allocation, and the efficient use of regional resources [4]. The World Bank's recent assessment of Uzbekistan also emphasizes the importance of increasing total factor productivity, improving transport and energy infrastructure, strengthening connectivity between territories and markets, and creating more favorable spatial conditions for private-sector development as essential components of the country's transition toward a more productivity-driven growth model [5].

The relevance of agglomeration efficiency is further reinforced by Uzbekistan's current strategic development priorities. Presidential Decree No. PF-158 of September 11, 2023, which approved the “Uzbekistan–2030” Strategy, identifies integrated territorial development and urbanization as major components of the country's long-term transformation agenda. The Strategy envisages increasing the national urbanization rate from 51 percent to 60 percent by 2030, transforming Samarkand and Namangan into cities with populations exceeding one million, increasing the number of cities and districts with populations above 300,000 to 28, and improving the spatial planning of settlements [6]. Furthermore, Presidential Decree No. PF-21 of February 16, 2026 strengthened

the implementation framework of the “Uzbekistan–2030” Strategy in response to contemporary global economic and technological transformations and emphasized the transition toward a more result-oriented system of strategic planning based on the “goal–action–result” principle [7].

A further institutional foundation for integrating agglomeration development with regional economic potential was established by Presidential Resolution No. PQ-245 of July 8, 2024, “On Measures to Realize the Economic Potential of Territories and Ensure the Efficient Use of Vacant Land Plots.” The Resolution provides for the preparation of master plans aimed at accelerating urbanization, developing cities and district centers, and establishing agglomeration territories [8]. In addition, Presidential Resolution No. PQ-252 of July 7, 2026 introduced further measures to accelerate reforms in urbanization and housing development, improve urban-planning documentation, expand the application of master-planning instruments and modern geourbanistic approaches, and strengthen institutional cooperation with UN-Habitat. These institutional transformations indicate that agglomeration development is increasingly becoming an important component of Uzbekistan's territorial development policy.

However, an important methodological gap remains between the institutional promotion of agglomeration processes and the economic measurement of their actual effectiveness. Existing approaches often emphasize population concentration, urbanization rates, infrastructure provision, or the scale of economic activity separately. Such indicators characterize the size and intensity of agglomeration, but they do not necessarily reveal its economic efficiency. A region may exhibit high economic density while failing to generate proportionate improvements in productivity, resource-use efficiency, market accessibility, or overall economic performance. Conversely, territories characterized by moderate spatial concentration may achieve comparatively high economic outcomes through more efficient combinations of productive resources, infrastructure, labor, and institutional capacity. Therefore, agglomeration intensity and agglomeration efficiency should be analytically distinguished.

The theoretical foundations of agglomeration economics have evolved from explaining the geographical concentration of firms toward identifying the mechanisms through which spatial concentration generates productivity advantages and improves the utilization of territorial resources. Within this framework, Duranton and Puga systematized the micro-foundations of urban agglomeration economies around three fundamental mechanisms: sharing, matching, and learning. Sharing refers to the joint use of indivisible facilities, infrastructure, suppliers, and specialized services; matching reflects the efficiency gains arising from larger and more diversified labor and input markets; and learning captures knowledge diffusion, technological interaction, and human-capital accumulation generated by geographical proximity. Their framework is particularly important for the present study because it demonstrates that agglomeration efficiency should not be identified solely with population or firm concentration. Instead, efficiency depends on whether spatial concentration activates mechanisms capable of transforming available resources into productivity gains.

Rosenthal and Strange extended this conceptual foundation by examining the empirical nature and sources of agglomeration economies across industrial, geographical, and temporal dimensions. Their review demonstrates that agglomeration externalities are spatially bounded and generally decline with distance. They also provide empirical support for the classical Marshallian mechanisms of labor-market pooling, input sharing, and knowledge spillovers while emphasizing additional determinants such as natural advantages, home-market effects, consumption opportunities, and institutional conditions. This

contribution has direct methodological implications for integrated agglomeration assessment: the economic effect of agglomeration cannot be adequately captured by a single density indicator because the magnitude of agglomeration externalities depends simultaneously on sectoral structure, spatial proximity, economic interaction, and time.

A major empirical contribution to the relationship between spatial concentration and economic performance was made by Ciccone and Hall. Using data across U.S. states and counties, they investigated how the density of economic activity influences labor productivity. Their estimates indicated that a doubling of employment density was associated with an approximately 6 percent increase in average labor productivity, while differences in economic density explained a substantial proportion of cross-state productivity variation. The significance of this result extends beyond the conventional density–productivity relationship. It suggests that territorial concentration can operate as an endogenous productivity-enhancing mechanism through which existing labor, capital, and production capacities are used more intensively. Nevertheless, density itself represents an input or structural characteristic rather than a comprehensive measure of efficiency. For this reason, the present research treats economic density as one component of agglomeration potential rather than as an ultimate indicator of agglomeration efficiency.

Glaeser and Maré approached agglomeration from the perspective of human capital and urban wage dynamics. Their empirical evidence showed that workers in cities earned substantially more than comparable workers outside urban areas and that a meaningful part of this wage premium accumulated gradually through urban work experience. Importantly, some of these productivity-related advantages persisted even after workers moved away from cities. This finding supports the proposition that agglomerations function not only as locations where existing productive resources are concentrated but also as environments in which new productive capabilities are generated through learning, interaction, and human-capital accumulation. Therefore, the efficiency of regional agglomerations should incorporate the capacity of territorial concentration to enhance the productive quality of labor resources rather than merely measuring the quantity of employment concentrated within a particular area [9].

Henderson provided further evidence regarding the sectoral specificity of agglomeration externalities by estimating plant-level production functions for machinery and high-technology industries. His findings demonstrate that localization economies may differ considerably across industries. In particular, the presence of other establishments from the same industry generated strong productivity effects in high-technology activities, whereas comparable effects were weaker in machinery production. The study also found that single-plant firms may both benefit more from and generate stronger external effects because of their greater dependence on the surrounding economic environment. These results challenge approaches that assume a homogeneous agglomeration effect across all sectors and regions. For the assessment of Uzbekistan's regional agglomerations, this implies that differences in industrial specialization, sectoral concentration, enterprise structure, and productive composition should be incorporated into the measurement framework [10].

Puga synthesized the accumulated theoretical and empirical evidence on the magnitude and causes of agglomeration economies and emphasized that firms and workers generally exhibit higher productivity in larger and denser urban environments. He identified three broad empirical approaches for detecting agglomeration economies: examining industrial clustering beyond what comparative advantage would predict, analyzing spatial patterns in wages and rents, and estimating systematic relationships between productivity and characteristics of the urban environment. At the same time, Puga emphasized that

identifying the existence of agglomeration economies is analytically different from identifying their underlying causal mechanisms. This distinction is fundamental for an efficiency-oriented methodology. A region may display high concentration without realizing proportionate economic benefits, while another may generate significant productivity effects from a comparatively smaller agglomeration base. Accordingly, an integrated framework should distinguish between agglomeration intensity, agglomeration potential, and realized agglomeration efficiency [11].

Combes, Duranton, Gobillon, Puga, and Roux advanced the empirical literature by addressing an important identification problem: whether higher productivity in large cities results from genuine agglomeration economies or simply from the spatial selection of more productive firms. Using French establishment-level data and a quantile-based empirical strategy, they showed that stronger firm selection alone could not explain observed spatial productivity differences. Instead, the evidence supported the presence of genuine productivity advantages associated with agglomeration. This contribution is methodologically important because it demonstrates that observed economic concentration and economic performance should not automatically be interpreted as a causal relationship. Unobserved heterogeneity, firm selection, regional comparative advantages, and endogenous location decisions may bias conventional estimates. Consequently, an integrated assessment of agglomeration efficiency for Uzbekistan should be complemented by econometric procedures capable of distinguishing the contribution of agglomeration mechanisms from the effects of pre-existing regional economic advantages [12].

Ahlfeldt, Redding, Sturm, and Wolf substantially extended spatial agglomeration analysis by developing a quantitative model that simultaneously incorporates agglomeration and dispersion forces within the internal structure of a city. Using the historical division and subsequent reunification of Berlin as a source of exogenous spatial variation, the authors identified substantial but highly localized production and residential externalities. Their analysis demonstrates that urban economic performance results from the interaction between accessibility, commuting costs, production externalities, residential externalities, and spatial equilibrium. This perspective is particularly relevant for the present research because it moves beyond administrative definitions of regions and emphasizes functional economic interaction. For Uzbekistan, where regional economic activity increasingly extends across formal administrative boundaries, agglomeration efficiency should therefore reflect transport accessibility, labor mobility, economic connectivity, and the intensity of interactions between core urban centers and surrounding territories [13].

Combes and Gobillon provided one of the most comprehensive methodological syntheses of the empirical agglomeration literature. Their integrated framework emphasizes several challenges that directly affect the reliability of agglomeration estimates: endogeneity at both local and individual levels, the selection of appropriate productivity measures, spatial scale, heterogeneity among firms and workers, functional-form assumptions, and endogenous location choices. They further distinguish static from dynamic agglomeration effects and demonstrate that local density represents only one among several theoretically relevant determinants of productivity. This approach provides an essential methodological foundation for constructing a multidimensional assessment framework. In particular, it suggests that a robust measure of agglomeration efficiency should combine indicators of economic concentration with measures of productive outcomes, accessibility, labor-market performance, sectoral structure, and the utilization of regional resources rather than mechanically aggregating urbanization indicators [14].

The reviewed literature therefore reveals a clear evolution in agglomeration research. Early empirical approaches primarily sought to establish whether

economic density and geographical concentration generate productivity advantages [8], whereas subsequent studies investigated the underlying mechanisms of sharing, matching, learning, specialization, human-capital accumulation, firm selection, accessibility, and spatial equilibrium [14]. Despite this substantial theoretical and empirical progress, three methodological limitations remain particularly relevant to the present study. First, much of the literature measures the economic effects of agglomeration rather than the efficiency with which regional economic potential is converted into those effects. Second, individual studies frequently concentrate on specific outcomes—productivity, wages, density, firm performance, or accessibility—without integrating them into a unified multidimensional efficiency framework. Third, empirical evidence remains concentrated predominantly in developed economies with mature urban systems and extensive micro-level databases, limiting the direct applicability of established coefficients and measurement thresholds to structurally transforming economies such as Uzbekistan.

Accordingly, the scientific gap addressed in this study lies in developing an integrated methodology that analytically separates available regional economic potential, agglomeration intensity, and realized economic efficiency. Rather than treating agglomeration as synonymous with urban size or economic density, the proposed framework conceptualizes agglomeration efficiency as the capacity of a spatially concentrated regional system to transform its productive, labor, infrastructural, investment, and market resources into measurable economic outcomes. Such an approach extends the existing literature from the question of whether agglomeration generates economic benefits toward the more policy-relevant question of how efficiently different regions transform agglomeration potential into realized economic performance. This distinction provides the theoretical basis for constructing an integrated agglomeration efficiency assessment for the regions of Uzbekistan.[15].

2. Materials and Methods

The study applies a multidimensional methodological approach to assess the efficiency of agglomeration processes in utilizing the economic potential of Uzbekistan's regions. Comparative analysis, statistical grouping, normalization, index construction, correlation, and econometric methods are employed. Regional economic potential is evaluated through indicators of production, investment, labor resources, infrastructure, entrepreneurship, and market capacity, while agglomeration efficiency reflects the ability of spatial concentration to transform these resources into measurable economic outcomes.

An integrated Agglomeration Efficiency Index (AEI) is constructed using normalized indicators of economic concentration, productive performance, infrastructure connectivity, labor-market efficiency, investment intensity, and resource utilization. The resulting index enables comparative assessment and classification of Uzbekistan's regions according to their agglomeration efficiency. Econometric analysis is subsequently used to determine the relationship between agglomeration intensity, regional economic potential, and realized economic performance.

3. Result

The empirical analysis is structured across three interconnected spatial levels to provide a comprehensive assessment of agglomeration efficiency and the utilization of regional economic potential in Uzbekistan. First, the study examines the dynamics of economic potential across all regions of Uzbekistan over the 2016–2025 period, focusing on changes in gross regional product (GRP), GRP per capita, and the intensity of regional economic transformation. This national-level

comparison makes it possible to identify spatial disparities in the capacity of regions to convert available productive and demographic resources into economic outcomes and provides an empirical basis for distinguishing between the scale of economic concentration and its actual efficiency.

The second and third stages progressively deepen the spatial analysis by focusing on the Fergana Valley – Andijan, Namangan, and Fergana regions – and the internal territorial structure of Namangan region. The Fergana Valley is assessed as a potentially polycentric economic system characterized by complementary industrial, service, investment, and labor-market functions, while the district-level analysis of Namangan identifies the functional relationships between the regional core, secondary economic nodes, and peripheral territories. This multi-level analytical framework enables the study to determine how economic concentration, sectoral specialization, investment activity, infrastructure connectivity, and territorial interaction jointly shape agglomeration efficiency and the transformation of regional economic potential into realized economic performance.

Table 1.

Regional differentiation in economic potential and its utilization across Uzbekistan

Region	GRP 2016, bln UZS	GRP 2025, bln UZS	GRP growth, times	GRP per capita 2016, ths. UZS	GRP per capita 2025, ths. UZS	Per capita growth, times	Transfor- mation profile
Republic of Karakalpakstan	10,524.5	54,076.9	5.14	5,833.0	26,489.5	4.54	Moderate
Andijan	18,376.6	107,717.6	5.86	6,258.0	30,852.1	4.93	Above average
Bukhara	16,594.9	86,608.1	5.22	9,071.2	41,399.1	4.56	Moderate
Jizzakh	8,719.4	52,956.7	6.07	6,767.1	34,116.8	5.04	Accelerating
Kashkadarya	23,743.4	98,783.4	4.16	7,766.4	26,856.9	3.46	Relatively constrained
Navoi	12,739.3	167,964.6	13.18	13,620.6	152,238.2	11.18	High-intensity
Namangan	15,062.1	85,419.0	5.67	5,731.6	27,020.6	4.71	Above average
Samarkand	25,429.8	121,489.5	4.78	7,029.1	28,001.8	3.98	Moderate
Surkhandarya	13,878.7	66,186.5	4.77	5,695.0	22,223.4	3.90	Relatively constrained
Syrdarya	6,802.1	35,794.4	5.26	8,536.8	38,137.2	4.47	Moderate
Tashkent reg.	26,724.2	180,177.4	6.74	9,504.6	57,480.2	6.05	High-intensity
Fergana	21,206.6	111,305.3	5.25	5,999.1	26,603.6	4.43	Moderate
Khorezm	11,568.7	62,987.5	5.44	6,566.4	30,713.5	4.68	Above average
Tashkent city	42,307.8	367,222.3	8.68	17,564.6	116,747.3	6.65	Metropolitan concentration
Republic of Uzbekistan	290,213.4	1,849,650.0	6.37	9,112.5	48,816.4	5.36	National benchmark

Source: Author's calculations based on data from the National Statistics Committee of the Republic of Uzbekistan. GRP and GRP per capita are measured at current prices.

The results presented in Table 1 demonstrate substantial interregional differentiation in the utilization of economic potential across Uzbekistan during 2016–2025. At the national level, GDP increased from UZS 290,213.4 billion to UZS 1,849,650.0 billion, representing a 6.37-fold nominal increase, while GDP per capita rose 5.36 times. Navoi region recorded the strongest dynamics, with GRP increasing 13.18 times and GRP per capita 11.18 times. Tashkent city demonstrated a 8.68-fold increase in GRP and a 6.65-fold rise in per capita GRP, while Tashkent region achieved corresponding growth rates of 6.74 and 6.05 times. In contrast, the Fergana Valley regions displayed relatively moderate dynamics: GRP increased 5.86 times in Andijan, 5.67 times in Namangan, and 5.25 times in Fergana, while their per capita GRP growth amounted to 4.93, 4.71, and 4.43 times, respectively.

These differences indicate that the scale and intensity of regional economic transformation remain spatially uneven.

From an agglomeration perspective, the observed disparities demonstrate that the expansion of regional economic output cannot itself be regarded as evidence of efficient utilization of economic potential. Regions characterized by stronger industrial specialization, capital concentration, infrastructure accessibility, and metropolitan functions exhibit a greater capacity to transform available resources into economic outcomes. Conversely, the relatively lower per capita performance of densely populated regions suggests the existence of unrealized agglomeration potential, where demographic and economic concentration has not yet been fully converted into productivity advantages. This finding substantiates the need for an integrated agglomeration efficiency assessment that simultaneously considers economic concentration, productive capacity, infrastructure connectivity, labor-market performance, and resource-use outcomes rather than relying exclusively on aggregate GRP dynamics.

Table 2.

Comparative assessment of economic potential and agglomeration preconditions in the Fergana valley regions

Indicator	Andijan Region	Namangan Region	Fergana Region	Fergana Valley Total / Profile
Permanent population, thousand persons	3,487.9	3,158.4	4,181.0	10,827.3
GRP, billion UZS	107,717.6	85,419.0	111,305.3	304,441.9
Real GRP growth rate, %	6.8	8.2	8.1	High-growth zone
GRP per capita, thousand UZS	30,852.1	27,020.6	26,603.6	—
Agriculture, forestry and fishing, billion UZS	30,535.0	23,483.2	28,322.7	82,340.9
Agriculture share in GRP, %	28.3	27.5	25.4	Diversifying
Industry, billion UZS	30,726.7	14,098.6	21,236.5	66,061.8
Industry share in GRP, %	28.5	16.5	19.1	Industrial concentration
Industrial production, trillion UZS	107.9	40.1	59.4	207.4
Construction, billion UZS	6,335.6	6,532.9	7,952.9	20,821.4
Construction share in GRP, %	5.9	7.6	7.1	Infrastructure expansion
Services, billion UZS	37,767.2	39,937.5	51,443.8	129,148.5
Services share in GRP, %	35.1	46.8	46.2	Service-oriented transformation
Share in Uzbekistan's GDP, %	5.8	4.6	6.0	16.4
Economic output per resident, million UZS	30.88	27.05	26.62	—
Dominant agglomeration function	Industrial-production	Service-growth	Service-industrial	Polycentric economic system
Agglomeration development potential	High	Very high	Very high	High integration potential

Source: Author's calculations based on the National Statistics Committee of the Republic of Uzbekistan.

The 2025 comparative assessment reveals substantial structural differentiation among the three regions of the Fergana Valley despite their geographical proximity and common economic space. Fergana recorded the largest GRP at UZS 111,305.3 billion, followed by Andijan at UZS 107,717.6 billion and Namangan at UZS 85,419.0 billion, bringing the combined economic output of the Valley to approximately UZS 304.4 trillion. Andijan demonstrated the strongest industrial profile, with industry accounting for 28.5% of GRP and industrial production reaching UZS 107.9 trillion. In contrast, services accounted for 46.8% of GRP in Namangan and 46.2% in Fergana, indicating a stronger service-oriented transformation. GRP per capita remained highest in Andijan at UZS 30.85 million, compared with UZS 27.02 million in Namangan and UZS 26.60 million in Fergana. At the same time, Namangan and Fergana recorded relatively

high real GRP growth rates of 8.2% and 8.1%, respectively, compared with 6.8% in Andijan, suggesting an ongoing redistribution of economic growth potential within the Valley.

From an agglomeration perspective, these differences indicate that the Fergana Valley should not be interpreted as three isolated regional economies but as a potentially interconnected polycentric economic system with complementary functional specializations. Andijan's industrial concentration, Namangan's expanding service sector, and Fergana's diversified service-industrial structure create favorable conditions for strengthening interregional production, labor-market, transport, and service linkages. However, differences in per capita output and sectoral productivity suggest that the existing demographic and economic concentration has not yet been fully transformed into agglomeration efficiency. Strengthening functional connectivity between the three regional centers and their surrounding districts could therefore generate additional agglomeration externalities through specialization, market integration, labor mobility, shared infrastructure, and more efficient allocation of productive resources.

Table 3.

Integrated assessment of economic and agglomeration potential across Namangan

Territory	Industrial output, bln UZS	Market services, bln UZS	Fixed-capital investment, bln UZS	Construction works, bln UZS	Industrial output per capita, mln UZS	Agglomeration function
Namangan c.	11,580.4	14,926.8	6,879.5	3,986.4	15.98	Regional core
Namangan d.	2,058.7	1,413.6	1,132.8	618.7	10.73	Suburban production-service zone
Mingbulak	1,026.3	767.5	1,085.7	421.3	7.21	Agro-industrial periphery
Kasansay	1,721.5	1,226.4	1,094.8	538.6	7.21	Industrial-agricultural node
Naryn	1,338.9	985.7	862.4	473.2	7.25	Agro-service zone
Pap	5,046.2	1,438.5	3,287.6	1,164.8	21.40	Industrial-investment node
Turakurgan	4,318.7	1,659.3	2,194.5	917.6	17.46	Industrial-energy corridor
Uychi	1,739.8	1,286.7	1,008.6	521.4	7.51	Production-service zone
Uchkurgan	1,867.4	1,173.8	974.3	506.8	10.15	Industrial-agricultural node
Chartak	1,496.5	1,184.6	1,023.7	497.5	6.79	Tourism-service node
Chust	4,209.6	1,864.2	1,742.5	936.7	14.38	Industrial-craft center
Yangikurgan	1,694.2	1,211.9	1,048.6	493.8	7.42	Agro-industrial zone
Namangan region	38,098.2	29,139.0	22,335.0	11,077.0	12.20	Polycentric regional agglomeration

Source: Author's calculations and systematization based on 2025 territorial indicators of the Namangan Region Statistics Department.

4. Discussion

The district-level assessment for 2025 reveals pronounced spatial concentration and functional differentiation within the Namangan regional economy. Namangan city acts as the dominant agglomeration core, with industrial output of UZS 11,580.4 billion, market services of UZS 14,926.8 billion, and fixed-capital investment of UZS 6,879.5 billion, confirming its central role in concentrating production, services, capital, and market functions. Among the

districts, Pap demonstrates the highest industrial output per capita at UZS 21.40 million, followed by Turakurgan at UZS 17.46 million, Namangan city at UZS 15.98 million, and Chust at UZS 14.38 million. Pap also records substantial fixed-capital investment of UZS 3,287.6 billion, while Turakurgan and Chust emerge as important industrial and infrastructure nodes. In contrast, Chartak, Mingbulak, Kasansay, Naryn, Uychi, and Yangikurgan display industrial output per capita below UZS 8 million, indicating considerable intra-regional differences in the intensity of productive resource utilization.

These disparities demonstrate that the Namangan regional agglomeration has a polycentric but hierarchically differentiated spatial structure, in which Namangan city performs the dominant core function while Pap, Turakurgan, and Chust operate as secondary economic nodes with specialized productive capacities. The principal challenge is therefore not simply to increase economic concentration in the regional center, but to strengthen functional linkages between the core, secondary nodes, and peripheral districts. Improved transport accessibility, inter-district labor mobility, production linkages, shared infrastructure, and specialization could facilitate the diffusion of agglomeration benefits beyond Namangan city. Consequently, the observed territorial differentiation supports the proposed integrated assessment approach: agglomeration efficiency should be evaluated according to the capacity of the regional system to transform spatial concentration and locally available economic potential into more balanced and interconnected economic performance across its constituent territories.

5. Conclusion

The results of the study demonstrate that agglomeration efficiency should be interpreted not merely as the spatial concentration of population and economic activity, but as the capacity of a regional economic system to transform its available productive, labor, investment, infrastructural, and market potential into measurable economic outcomes. The empirical analysis conducted at the national, Fergana Valley, and intra-regional levels confirms substantial spatial heterogeneity in this transformation process. Accordingly, improving the efficiency of agglomeration development in Uzbekistan requires a transition from predominantly scale-oriented territorial assessment toward an integrated approach that simultaneously considers economic potential, agglomeration intensity, functional connectivity, and realized economic performance.

First, the analysis for 2016–2025 reveals significant differences in the dynamics of economic potential utilization across Uzbekistan. National GDP increased from UZS 290,213.4 billion to UZS 1,849,650.0 billion, representing a 6.37-fold nominal expansion, while GDP per capita increased 5.36 times. However, regional trajectories were highly differentiated: Navoi recorded a 13.18-fold increase in GRP and an 11.18-fold increase in GRP per capita; Tashkent city achieved corresponding increases of 8.68 and 6.65 times, while Tashkent region recorded 6.74 and 6.05 times. These results indicate that economic concentration generates different transformation effects depending on the structure and quality of regional productive capacity. Therefore, it is proposed to introduce an Agglomeration Efficiency Index (AEI) into regional assessment practice, integrating economic concentration, productive performance, infrastructure connectivity, labor-market efficiency, investment intensity, and resource utilization instead of evaluating agglomeration development solely through population size or GRP growth.

Second, the Fergana Valley demonstrates considerable potential for the formation of an integrated polycentric agglomeration system. In 2025, the combined GRP of Andijan, Namangan, and Fergana regions amounted to approximately UZS 304.4 trillion, accounting for 16.4% of Uzbekistan's GDP.

Nevertheless, structural differences remain substantial: Andijan's industrial share reached 28.5% of GRP, while services represented 46.8% in Namangan and 46.2% in Fergana. GRP per capita also varied from UZS 30.85 million in Andijan to UZS 27.02 million in Namangan and UZS 26.60 million in Fergana. Rather than viewing these differences solely as disparities, regional policy should utilize them as complementary functional advantages. It is therefore recommended to develop a Fergana Valley Polycentric Agglomeration Framework based on coordinated industrial specialization, integrated transport corridors, interregional labor mobility, shared logistics infrastructure, and interconnected service markets.

Third, the district-level assessment of Namangan region identifies a hierarchically differentiated agglomeration structure. Namangan city functions as the dominant economic core, generating UZS 11,580.4 billion in industrial output, UZS 14,926.8 billion in market services, and attracting UZS 6,879.5 billion in fixed-capital investment. At the same time, Pap recorded the highest industrial output per capita at UZS 21.40 million, followed by Turakurgan at UZS 17.46 million, Namangan city at UZS 15.98 million, and Chust at UZS 14.38 million. In contrast, several districts remained below UZS 8 million in industrial output per capita. This spatial asymmetry suggests that concentrating additional economic functions exclusively in Namangan city may deepen core-periphery disparities. A more effective approach would be to strengthen Namangan-Turakurgan-Chust-Pap secondary economic nodes and connect them with surrounding districts through transport, production, logistics, labor-market, and service networks.

Fourth, the methodological findings demonstrate that agglomeration intensity, economic potential, and agglomeration efficiency constitute related but conceptually distinct categories. High economic density does not automatically generate high efficiency, while a territory with relatively moderate concentration may achieve superior results through more productive resource combinations. Therefore, the proposed integrated methodology should distinguish between a region's initial economic potential and its realized performance. From a methodological perspective, regional monitoring should incorporate a "potential-concentration-connectivity-result" analytical chain and calculate an agglomeration efficiency gap, defined as the difference between expected economic performance based on available regional potential and actually realized outcomes. This would enable policymakers to identify not only economically weak territories but, more importantly, regions possessing substantial yet underutilized economic potential.

Fifth, improving agglomeration efficiency requires shifting territorial policy from administratively fragmented development toward functional economic-area management. Transport accessibility, commuting flows, production and supply-chain relationships, market-service interactions, infrastructure sharing, and inter-district labor mobility should be used alongside administrative boundaries when determining agglomeration zones. It is recommended to establish a digital regional monitoring platform integrating statistical, geospatial, infrastructure, enterprise, investment, and labor-market information. Such a platform would enable continuous monitoring of agglomeration externalities, identification of emerging economic nodes, evaluation of infrastructure bottlenecks, and evidence-based allocation of public investment. In practical terms, priority should be given to projects that increase connectivity between agglomeration cores and peripheral territories rather than projects that merely increase the concentration of assets within already dominant centers.

Sixth, the study ultimately suggests that the strategic objective of agglomeration policy in Uzbekistan should not be the mechanical enlargement of cities or further concentration of economic resources, but the maximization of the economic return generated by spatial interaction. Regional development mechanisms should therefore combine differentiated specialization, polycentric

development, infrastructure integration, coordinated investment planning, and performance-based territorial governance. The proposed AEI can serve as an analytical instrument for classifying regions according to their capacity to convert economic potential into realized outcomes and for designing differentiated policy measures for high-efficiency, emerging, and underutilized agglomeration systems. Its systematic application would provide a methodological basis for directing infrastructure and investment resources toward territories with the greatest unrealized agglomeration potential, strengthening interregional economic integration, and transforming spatial concentration into sustainable and more balanced regional economic development.

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