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Theoretical Foundations of Assessing The Impact of Regional Infrastructure on Social Stratification

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Abstract: The article examined the theoretical foundations of assessing how regional infrastructure affected social stratification and developed a coherent conceptual model. The researcher substantiated an integrative analytical approach grounded in Aschauer's public capital hypothesis, Hansen's classification of infrastructure, and the models of Calderón-Servén and Chatterjee-Turnovsky. Four principal channels of regional differentiation were identified: production efficiency, human capital quality, market access, and logistical connectivity. The dynamics of poverty and the Gini coefficient across Uzbekistan's regions during 2021-2025 were analyzed through open sources of international financial institutions. The role of public investments and infrastructure projects in reducing territorial inequality was evaluated. The conclusions strengthened the theoretical and methodological foundation of regional development programs.

Keywords: regional infrastructure, social stratification, Gini coefficient, poverty, public capital, human capital, economic growth, territorial differentiation.

1. Introduction

Regional infrastructure - the aggregate of road, energy, water supply, education, healthcare and digital communication systems within a territory - has become one of the principal factors that determine production efficiency in the national economy and the quality of life of the population. Disparities in the territorial distribution of public capital may either reinforce or, conversely, narrow the differences between population groups in income, education, health and employment. This relationship serves to ensure the required pace of macroeconomic growth while also revealing the theoretical and applied dimensions of policies aimed at strengthening social justice.

The economic reforms implemented in Uzbekistan since 2017, together with the "Uzbekistan - 2030" Strategy adopted in 2023, defined regional development as one of the priority directions [1]. The high pace of economic growth - in particular, real GDP reaching 7.7 per cent in 2025 and the poverty rate falling to 5.8 per cent - is explained by the steady inflow of foreign and public investments into infrastructure projects [2]. The decline of the Gini coefficient, which reflects income disparities between social groups, from 0.35 in 2024 to 0.33 in 2025 demonstrates the effectiveness of regional development policy [3].

The theoretical link between regional infrastructure and social stratification has an extensive empirical base in the international literature. Theoretical models have been refined over the period from the public capital hypothesis substantiated by Aschauer to the modern studies of authors such as Calderón-Servén and Chatterjee-Turnovsky [4]. The aim of the article is to formulate a coherent theoretical foundation for assessing the impact

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of infrastructure quality on social stratification in the case of Uzbekistan's regions and to substantiate it with reliable statistical sources. The scientific significance of the study is manifested in two directions: first, the conceptual foundations of assessing territorial disparities are systematised in a manner that connects international theoretical approaches with Uzbekistan's statistical base; second, the directions of state policy aimed at reducing territorial differentiation are illuminated through a reliable system of indicators.[5]

Literature Review

The macroeconomic assessment of the relationship between infrastructure and economic growth began with the pioneering 1989 work of D. Aschauer. He demonstrated that the productive properties of public capital significantly raise the marginal productivity of private capital, and this approach was subsequently named the "public capital hypothesis" [6]. R. Barro, within his endogenous growth model, incorporated productive public expenditure into the production function and mathematically substantiated the capacity of infrastructure to sustain long-run growth rates. Subsequent research in this direction examined, both theoretically and empirically, the differences in the impact of various types of infrastructure on production and human capital [7].

The concepts of economic and social infrastructure were distinguished by N. Hansen in 1965, and this classification has become the foundation of contemporary analytical models. According to Hansen's approach, "economic infrastructure" (roads, energy, telecommunications, water facilities) directly affects production efficiency, while "social infrastructure" (education, healthcare, culture, sport) contributes to long-run productivity through the formation of human capital [8]. The mutually complementary nature of the two types of infrastructure was also confirmed in the research conducted by Calderón and Servén.

One of the most comprehensive theoretical models on the impact of infrastructure on social stratification was developed by Chatterjee and Turnovsky. In their approach, public capital is interpreted simultaneously as a driver of growth and as an essential factor in the distribution of income and wealth. Under equilibrium conditions in the model, both growth rates and the level of inequality are determined endogenously; the source of financing for public investment (taxes, debt or transfers) affects inequality dynamics to varying degrees [9]. The authors demonstrated, with mathematical proof, that an increase in public capital may intensify wealth inequality in the short run, but in the long run - under appropriately targeted policy - it narrows income differences.

The empirical analysis carried out by Calderón and Servén was performed on the basis of panel data for 121 countries. The authors showed that an increase in the infrastructure stock accelerates GDP growth while substantially reducing the Gini coefficient. The expansion of telecommunications, electricity and road service networks grants the rural population access to the labour market and creates the basis for the narrowing of income disparities [10]. This conclusion was repeatedly confirmed in analytical works subsequently published by the World Bank [11].

In the context of Uzbekistan, the relationship between territorial differentiation and poverty has been extensively examined by the World Bank, the Center for Economic Research and Reforms (CERR) and the Statistics Agency. An analytical report published in 2024 stated that the country's poverty rate fell from 17 per cent in 2021 to 8.9 per cent in 2024; however, the Gini coefficient rose over the same period from 31.2 to 34.5. This outcome scientifically substantiates the necessity of balanced territorial allocation of public investments. The empirical findings of Calderón and Servén are consistent with Uzbekistan's data and indicate that targeted infrastructure investments contribute to the easing of stratification [12].

2. Materials and Methods

The study was conducted on the basis of a theoretical-analytical approach. In formulating the conceptual foundations, the methods of inductive and deductive logic, comparison and systemic synthesis were applied. As the source of empirical evidence, indicators selected from the open publications of the World Bank, the Asian Development

Bank, the Statistics Agency of the Republic of Uzbekistan and the Center for Economic Research and Reforms were drawn into the analysis [9].

The construction of the theoretical model proceeded in the following four stages. In the first stage, the economic and social types of infrastructure were separated on the basis of Hansen's classification. In the second stage, the channel through which each type affects social stratification was identified. In the third stage, a territorial dimension was introduced and a system of indicators was formulated: poverty rate, Gini coefficient, transport and digital communication coverage, and the level of access to education and healthcare services. In the fourth stage, the mechanism was tested with data from Uzbekistan's regions and finalised through the conceptual model [13].

The analysis covered the years 2021-2025. During this period, economic reforms in the country advanced to a new stage and a measure of poverty consistent with international standards was introduced [14]. This methodological change was taken into account in the choice of the analytical time frame, since the possibility of direct comparison with data from earlier periods is limited. As a limitation, it should be noted that no single direct index of infrastructure quality across regions exists; consequently, the analysis relied on the use of aggregate and proxy indicators. The statistical base was drawn from mature sources verified by international institutions, which raises the reliability of the results [15].

3. Results and Discussion

Regional infrastructure transmits its impact on social stratification through four principal channels: production efficiency (economic infrastructure), human capital quality (social infrastructure), access to market opportunities (transport and digital communication), and the level of territorial connectivity (logistical network). The analysis carried out in accordance with the conceptual scheme provided clear confirmation of the theoretical relationship in Uzbekistan's regions.

The first direction - the quality of the transport network - as the most direct production channel, redistributes productive employment gains across regions. In the World Bank's Logistics Performance Index ranking, Uzbekistan rose from 129th place in 2014 to 88th place in 2023 [16]. This achievement is the outcome of modern reforms in the transport sector and international financing. The modernisation of the M-39 road corridor and the infrastructure project linking Surkhandarya region with the central regions are being implemented within the framework of dedicated financing [17]. Quality differences in road infrastructure between regions determine the directions of commodity flows and labour migration.

The second direction - digital infrastructure - has emerged over the past six years as the fastest-growing component of Uzbekistan's economy. Exports of ICT-based services rose from 0.6 million dollars in 2017 to 140 million dollars in 2022. 4G/LTE coverage stood at 92 per cent in 2023, encompassing a substantial part of the national territory [18]. The population's digital literacy, however, stood at 15 per cent, and raising this indicator is significant as a means of narrowing stratification between social groups.

The third direction - social infrastructure - determines the territorial distribution of human capital through education and healthcare services. Tertiary enrolment stood at 31.5 per cent in 2023, lower than the average for Europe and Central Asia [19]. This figure dictates the necessity of additional investment in social infrastructure.

Along the fourth direction, the dynamics of poverty reduction across regions emerged as a direct outcome of infrastructure projects. Table 1 below clearly illustrates regional differentiation.

Table 1. Dynamics of the poverty rate in the regions of Uzbekistan
(2024-2025, percentage)

Region	2024 (%)	2025 (%)	Decrease (p.p.)
Tashkent city	7.3	3.5	3.8
Jizzakh region	11.8	5.8	6.0
Sirdaryo region	11.3	6.2	5.1
Khorezm region	11.9	6.7	5.2

Republic of Karakalpakstan	10.8	6.6	4.2
National average	8.9	5.8	3.1

The figures in Table 1 show that within one year the poverty rate in Jizzakh region was reduced by approximately half, while in Tashkent city it fell by more than twofold. The highest pace of decline was observed in regions located close to transport corridors and where major infrastructure projects have been implemented in recent years. This empirically substantiates the theoretical hypothesis - the balanced impact of infrastructure on the easing of social stratification [20].

The fifth direction of analysis concerns the volume of public and international investments. The Asian Development Bank has allocated 5.41 billion US dollars in financing to Uzbekistan over the past five years. The total amount of 27 projects implemented in cooperation with the World Bank is 5.6 billion dollars. The balanced distribution of these funds between rural and urban territories leads to a reduction in territorial stratification. The cumulative volume of infrastructure investments within the framework of climate change adaptation and decarbonisation for the period 2023-2060 has been estimated at more than 178 billion dollars. This constitutes a strategically significant reserve for the sustainability of long-run development.

The model in Figure 1 expresses the mechanism by which regional infrastructure, through its economic and social components, influences the distribution of income and opportunities. Economic infrastructure serves overall performance through productivity and the expansion of market access, while social infrastructure does so through the development of human capital and logistical linkage. The aggregate of these factors shapes income distribution and ultimately influences the level of social stratification in society.

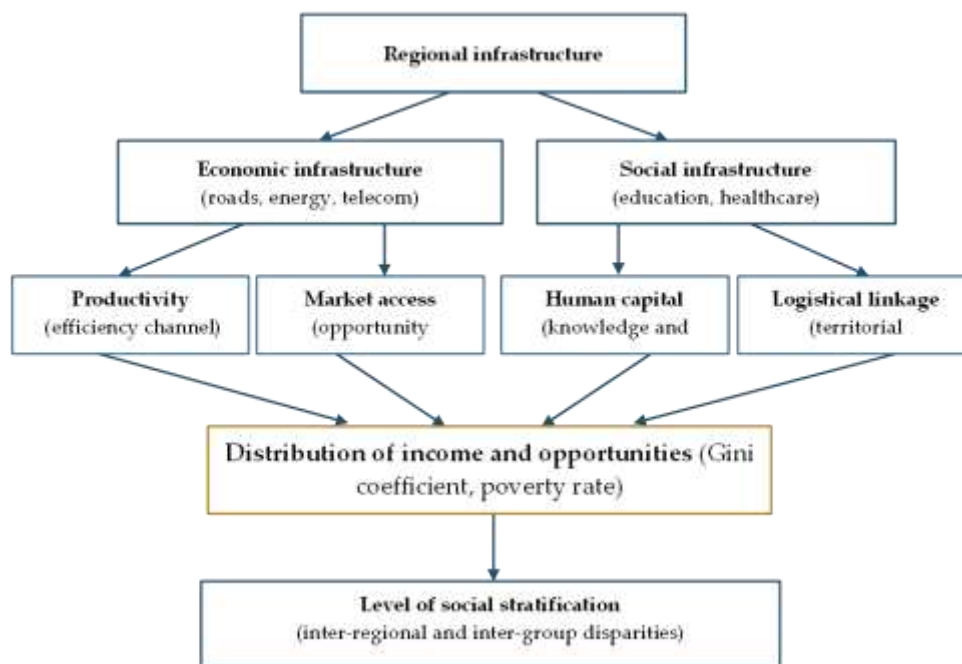


Figure 1. Conceptual model of the impact of regional infrastructure on social stratification

The results obtained provide an applied confirmation of the theoretical model under Uzbekistan's conditions. The decline of the poverty rate from 17 per cent in 2021 to 5.8 per cent in 2025 is a significant indicator confirming the social effects of infrastructure-based growth. The fall of the Gini coefficient to 0.33 in 2025 (from the previous 0.35) and the figure of 0.26 for Tashkent city attest to the gradual easing of stratification. In conceptual terms, the theoretical link between regional infrastructure and social stratification is expressed as a chain of mechanisms see Figure 1. Economic and social infrastructure are

mutually complementary; only when both are developed in balance does the most effective reduction of territorial disparities take place.

4. Conclusion

The study served to formulate a coherent theoretical foundation for assessing the impact of regional infrastructure on social stratification. An integrative approach drawing on Aschauer's public capital hypothesis, Hansen's distinction between economic and social infrastructure, and the models of Calderón-Servén and Chatterjee-Turnovsky was empirically substantiated with Uzbekistan's data. The steady decline in territorial poverty and the favourable dynamics of the Gini coefficient serve as reliable indicators of the effectiveness of state policy.

On the basis of the results obtained, the following proposals and recommendations were advanced. First, the construction of a unified index of regional infrastructure quality is expedient. Such an index will allow comparing transport, digital communication, energy, water supply and social service indicators across regions. Second, balanced financing of social and economic infrastructure projects is necessary. If investments are directed solely to transport or energy, the probability of falling behind in the spheres of education and healthcare increases, and differentiation in the composition of human capital may be observed.

Third, aligning the system of proxy indicators that capture territorial differentiation with the methodologies of the World Bank, the OECD and the United Nations is expedient. Fourth, presenting quarterly monitoring of poverty and the Gini coefficient by region guarantees a real-time information base for public administration and political decisions. Fifth, the targeted indicators of the "Uzbekistan - 2030" Strategy - keeping poverty below 8 per cent, expanding ICT exports, modernising transport corridors - necessitate the balanced regional distribution of infrastructure investments. Sixth, local financial mechanisms that reduce stratification - microcredit programmes for small business and targeted grants to rural areas - may serve as an additional means of ensuring the effective functioning of infrastructure.

The applied significance of the study consists in the fact that the proposed theoretical foundations strengthen the scientific basis of regional development programmes. The directions of state policy aimed at reducing territorial differentiation can be formulated more effectively through a reliable system of indicators. The conclusions obtained help to ensure the scientifically grounded selection of new infrastructure projects within Uzbekistan's cooperation with international organisations and are of significant importance in implementing a national strategy oriented towards inclusive growth.

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