

The impact of air transport infrastructure on the efficiency of using the region's production and resource potential

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Keywords

Region, production potential, resource potential, air transport infrastructure, economic agglomeration, impact, sustainability, integration

Abstract

The purpose of the study is to substantiate the scientific and theoretical provisions of the assessment of the impact of air transport infrastructure on the efficiency of using the region's production and resource potential. Research methodology - comparative analysis and synthesis, scientific abstraction, logical generalization methods were applied in the research process. After the database on the activities of new international airports put into operation in the liberated territories of Azerbaijan is formed, it is recommended to build a function that takes into account the passenger flow factor in air transport, calculate the elasticity coefficient included in it, apply the Difference in Differences (DiD) method, and simulate the effects on airports and surrounding areas on the basis of a panel data model. Research results - directions of positive impact of air transport infrastructure on the circular transformation of the region's resource potential into production potential, as well as on the formation of economic agglomerations were revealed. The applied significance of the study - the substantiated provisions and the obtained results can be used in the preparation of regional development programs, taking into account the factor of new airports. Scientific innovation. The directions of the impact of air transport infrastructure on the efficiency of using the production and resource potential of the region, the formation of a sustainable ecosystem have been determined, and the prospects of the impact of new airports in the country on the reintegration of surrounding areas have been shown. For the first time, the directions of the catalytic impact of air transport infrastructure on local initiatives promoting the efficient use of resources and the environment for the formation of economic agglomerations have been determined.

Introduction

Transport infrastructure has a significant impact on the efficiency of using the production and resource potential of surrounding areas and the sustainable socio-economic development of the regions in which it is located. This impact, in most cases, is not direct, but catalytic in nature. For this and other reasons, the impact discussed should be characterized in a comprehensive manner. However, the impact of air transport infrastructure on the efficiency of resource use in the region where it is located has not been adequately studied [Adali et al., 2024].

Three new international airports have been put into operation in the liberated regions of Azerbaijan. The infrastructure of these ports is expected to have a positive impact on the reintegration process of nearby territories. For these and other reasons, the scientific-theoretical and experimental problems of the impact of air transport infrastructure on the efficiency of use of the region's production and resource potential are quite relevant [Prus & Sikora, 2021]. Air transport infrastructure contributes to the transformation of the region's resource potential into production potential, innovation potential, the formation of economic agglomerations, sustainable development and a number of other areas.

Literature review

The basis of the development of the regional economy is its production and resource potential. In the sustainable socio-economic development of regions, the issue of ensuring the compliance of the environment for the use of its production and resource potential with new environmental challenges is considered relevant. An important issue is the assessment of the impact of exogenous factors affecting the efficiency of resource use. The use of resource potential implies its transformation into production

potential. This transformation is the process of converting opportunities into real products (services) through the use of raw materials, capital, experience and skills.

In modern times, the approach to the resource-technology-product system within the region based on the principle of a linear economy does not justify itself in terms of sustainable development criteria. The requirements for circular (regenerative) economic behavior imposed on business. As can be seen from the research [Stereov, 2019] are actively accompanied by the establishment and implementation of circular business models. In our opinion, more attention should be paid to the institutional and infrastructure problems of the transition from linear to circular business models.

A similar idea can be made about the impact of the infrastructure factor on the implementation of circular economic principles. As can be seen from the results of the conducted studies [Colak, 2026], air transport infrastructure is able to help implement the concept of a circular economy that highlights the climate change factor in ports and surrounding areas. Thus, thanks to this infrastructure, direct dependence on local resources and technologies and the need for their linear use are eliminated. The development of air transport infrastructure [Cruz & Saldaña, 2024] can also serve the integration of the transport system and the relevant region into the circular economy system. The development of transport infrastructure in accordance with the criteria of sustainable development is one of the important factors determining the state of utilization of the region's production and resource potential. The impact of air transport infrastructure on the investment climate in the region and the state of utilization of regional potential is related to the main technical and economic characteristics of the means of transport operating in that area, as well as air transport. In this regard, increasing the level of investment attractiveness is a matter worthy of special attention. The development of transport infrastructure, as shown by the conducted studies [Rogaczewski & Ejdyś, 2025], significantly increases investment attractiveness.

Air transport infrastructure is a regulated, complex and quite dynamic system of using physical and organizational resources necessary for aviation, including airports and traffic management systems. Thanks to the development of the infrastructure in question, air transport opens up new and quite real opportunities for the activation of natural and economic, especially financial resources. In the implementation of these opportunities, the regular operation of airports, the volume and intensity of passenger and cargo transportation plays the role of important factors. Thus, thanks to the development of air transport infrastructure, the following trends are quite clearly manifested in the region:

- formation and development of efficient logistics chains;
- increasing mobility of the workforce, improvement in the structure of employment due to technological development;
- formation of a favorable local economic development and business environment;
- acceleration of territorial integration.

The listed trends can ultimately have a positive impact on the rate of economic growth in the region. At the same time, it should be noted that the development of air transport infrastructure demonstrates the possibilities of intensification of cargo shipments in the region, formation of a multimodal system, and optimization of the distribution of products and resources.

As an important component of air transport infrastructure, the activity of ground services and their provision with high-tech equipment significantly affect economic activity and employment levels in the region. Studies [Adali et al., 2024] show that the activity of air transport networks directly affects the business activity of local entrepreneurs in the region and its efficiency. International airports are the gateway to the world for regions that do not have direct access to the sea. Thanks to them, the functioning of supply chains is ensured, transportation times are reduced [<https://www.peninsulatransport, 2023>]. As noted in the cited source, international airports, by ensuring the integration of geographically isolated regions into the world economy, eliminate physical borders, and improve transport accessibility in remote areas and on difficult roads.

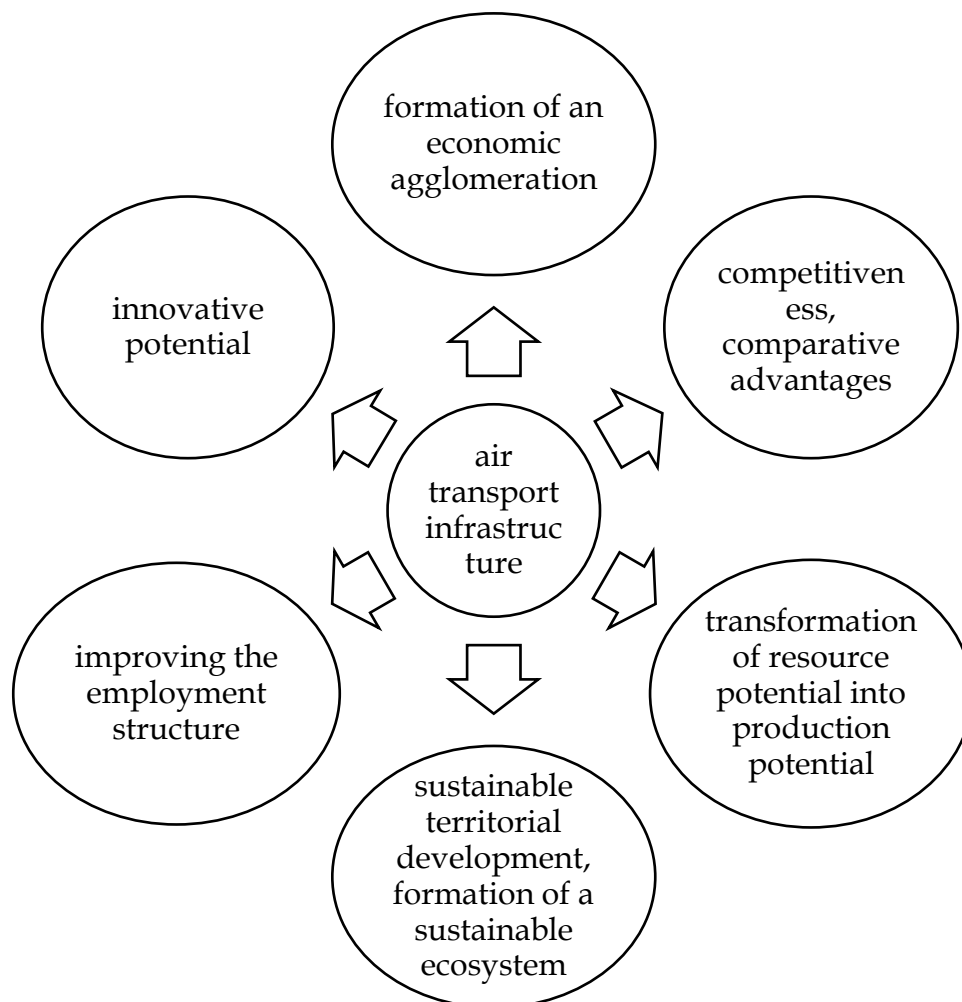
The impact of air transport infrastructure on the economic and social development of the region, especially on the efficiency of its production and resource potential, is manifested in various directions (scheme 1). The existing transport infrastructure, including air transport infrastructure, has a positive impact on innovation potential by accelerating the spread of knowledge, overcoming both physical and digital barriers, as well as reducing the costs of cooperation initiatives. The impact of the infrastructure in

question and its development on innovation potential, as already noted, manifests itself in various forms. The results of this impact improve the conditions for the use and mobilization of technical and financial resources, gradually form a new qualitative level in the activation of creative potential.

The operation of modern air transport infrastructure has a significant impact on the following components of regional development:

- the efficiency of digital and innovative infrastructure;
- the scope of spatial planning;
- the characteristics of internal migration supporting business activity, etc.

Characterizing innovation potential is an issue that deserves special attention in terms of sustainable socio-economic development of regions, technical-technological, as well as institutional support for the implementation of development strategies of these territories.



Scheme 1. Simplified scheme of the impact of air transport infrastructure on the efficiency of regional production and resource potential use.

Compiled by the author

The launch of new international airports in the region can lead to a new level of activation of existing innovation potential and improvement of results. In this regard, recent studies have paid special attention to the increased capabilities of airports [Dias & Silva, 2024]. The level of business participation in the process of activating the region's innovation potential is directly related to the degree of development of transport infrastructure in the area, depending on logistical capabilities, accessibility to scientific centers

and markets. The impact of transport infrastructure on innovative development is associated with the ability to transform relations into mutually beneficial economic activities on a regional scale. The effectiveness of information exchange, energy use, and the application of resource-saving technologies in the realization of the opportunities discussed depends on the efficiency of the transport system, which in turn depends on the extent to which the relevant infrastructure meets the requirements of regional economic integration.

The impact of sustainable transport infrastructure on innovation potential is realized through digital technologies [Jacyna-Golda et al., 2026]. The cited source pays special attention to the issues of the impact of digital integration on innovation potential. Here, successful attempts have also been made to quantitatively characterize the place and role of transport infrastructure in the process of forming the region's innovation potential. New airports, as a rule, act as leaders in innovative areas of activity in the region. For these and other reasons, their role in the ecosystem is increasing, and thanks to innovative approaches to using the territory's production and resource potential, a real opportunity arises for the region to become a center of business activity and sustainable development.

Research methodology

The necessary database on the activities of new airports put into operation in the liberated territories of Azerbaijan in recent years is in the process of formation. After this database reaches the necessary level, the following steps are recommended. In order to assess the impact of air transport infrastructure on the efficiency of using the region's production and resource potential, it is first advisable to determine the stages corresponding to the capabilities of the database. Then, a function that takes into account the passenger flow factor in air transport (for example, the Cobb Douglas function) can be constructed and implemented. To assess the impact of air transport infrastructure on the efficiency of production and resource potential use in the region (increasing business activity and accelerating economic growth), the elasticity coefficient included in the function should be calculated, along with other indicators. In the initial approach, it is advisable to apply the Difference in Differences (DiD) method. To evaluate the results obtained, it is recommended to simulate the trends created by both airports and their effects on the region on the basis of a panel data model (TWFE). Of course, the use of the effective two-factor regression mentioned for the assessment under the DiD model can be replaced by other approaches if the data are representative. Qualitative characterization of the impact of air transport infrastructure on the efficiency of production and resource potential use in the region and for generalizing the results of the analyses, expert assessments of the revealed trends are also needed.

Conclusions

The promotion of local initiatives by air transport infrastructure requires special attention to the problems of risk management. Thus, the probability of financial risks increases, and there is a serious need to adapt to modern challenges in the responses to environmental impacts. The need to adapt to the new challenges discussed is also manifested in the following areas:

- land use planning. Territorial planning should be carried out taking into account the nature and directions of transport infrastructure development. In the context of multi-purpose use of land resources, economic and environmental criteria are prioritized. The impact of air transport infrastructure on the comprehensive justification of land use decisions, which are the main means of production, is significantly expressed in the flexibility of the logistics system;
- the development of transport infrastructure in a context of increased probability of natural and financial risks, the rise of that development to a new quality level with the commissioning of new airports, requires the use of innovation potential without exception, priority given to sustainable development criteria;
- development of public-private partnerships;
- sustainable business activity.

The role of air transport infrastructure in the implementation of local initiatives is expressed in overcoming the difficulties associated with distance, improving accessibility to resources, and obtaining

greater benefits from local opportunities. The development of air transport infrastructure, as already mentioned, improves the structure of employment in the region, increases the attention of local and foreign investors to the potential of the region, and gives impetus to the development of specialized logistics and its integration with global networks. The stimulating effect of air transport on local economic initiatives is manifested in the development of the hotel business and tourism, as well as in the recognition of cultural and natural attractions in the region, the formation of specialized trade, social integration, and a number of other areas. Based on the results of relevant studies [Zajac, 2016], it can be said that the impact of airports on local economic initiatives in the region is most clearly manifested in the development of tourism.

To express our attitude to the role of air transport infrastructure in the formation of economic agglomerations, let us briefly consider agglomeration processes. The concentration of business entities and people in a limited area, thanks to common infrastructure, positive externalities, favorable conditions for labor and knowledge exchange, forms economic agglomerations. The development of transport infrastructure plays a decisive role in these processes [Boronenko et al., 2023]. Air transport is able to make a significant contribution to the integration of this agglomeration into a wider business environment. The sustainability of economic activity, resource provision and specialization factor determine the position of agglomerations in the social division of labor. Air transport infrastructure makes a fairly significant contribution to regional development by conditioning the sphere of influence of the listed factors. Joint use of resources reducing travel costs, creating new opportunities for personnel and knowledge exchange can boost urbanization processes by turning economic agglomerations into centers of attraction. In the context of economic decentralization processes, the compliance of air transport infrastructure development characteristics with modern requirements is of decisive importance.

Studies that reflect the positive impact of economic agglomerations and urbanization on economic growth to a greater or lesser extent [Liu et al., 2023] indicate that agglomerations with multiple centers are more favorable in terms of both economic and environmental development, unlike single-center agglomerations. There is a direct relationship between accessibility to resources and accessibility to transport in these centers. The increasing role of transport infrastructure in transforming local initiatives into a serious factor in terms of sustainable development and increasing employment levels is related to the level of integration of the region into the national economy [Zhang & Cheng, 2023]. Although this connection may not seem obvious at first glance, it is precisely the level of economic integration that acts as a factor determining the place and role of the region in the transport system.

Discussions and conclusions

In the modern era, the role of transport infrastructure, in which air transport also actively participates, is more important in expanding transit opportunities. The point is that in the formation and development of economic agglomerations, along with the scale factor, the speed and operational factors require a special approach. The increased attention to the speed factor increases the attention to the air transport system and its infrastructure. In this regard, the issues of transport accessibility and its impact on the state of production and resource potential utilization in the region come to the agenda [Kasraian et al., 2017]. Therefore, transport accessibility, considered as an evaluable opportunity for transportation, acts as an indicator characterizing the implementation of the sustainable development concept supporting the integration of the region into the national economy. The impact of transport infrastructure on the development of the territories in which it is located, as a system that carries out the movement of people and products, gradually increases in the process of forming a single economic space. Transport infrastructure, which includes physical objects and facilities necessary for the operation of transport, makes a fairly significant contribution to the formation of a sustainable economic activity space. In general, the growing role of air transport and its infrastructure in adapting urbanization processes to the concept of sustainable development in economic agglomerations supports the process of forming a single activity space.

The development of air transport infrastructure is a condition and, in a certain sense, a result of the development of transport, energy and digital networks in the region. The formation of opportunities for

the joint use of energy resources and a comprehensive assessment of the specific role of air transport infrastructure in their implementation become an objective necessity. The point is that activities in accordance with the green airport concept require different approaches to the environment. It is enough to note that the flora and fauna that find shelter around new airports form a unique habitat. For these and other reasons, they are not at all safe in terms of environmental impact to neutralize the negative aspects of the impact of non-standard airports on the atmosphere, soil and water, as a rule, the most advanced technological solutions are used.

As the quality of air transport infrastructure increases to the level of modern requirements, its positive impact on territorial development increases. According to the results of relevant studies [Chaitarin, 2025], in the context of the priority of sustainable regional development, air transport infrastructure is able to play a significant role in the stability of the logistics chain in the region and in ensuring sustainable economic growth in the long term. An acceptable level of intra-regional economic integration can turn transport infrastructure into an environment-creating factor in terms of sustainable ecosystem requirements in the value chains of products. There is a fairly close relationship between the quality of transport infrastructure and productivity in the region. It is precisely new airports, quality roads and modern railway stations that form a favorable environment for the efficient operation of economic entities by reducing transportation costs [Deng, 2013].

The developed air transport infrastructure increases the competitiveness of the region to one degree or another. Studies [Nedeva & Genchev, 2018] show that the indirect impact of air transport, including passenger and cargo flows, on the competitiveness of the region is undeniable and this impact manifests itself gradually. The impact in question is indirect and is manifested mainly in the following areas:

- integration of local markets into international markets;
- support for the development of high-tech industries;
- significant contribution to the positive scale effect;
- formation of knowledge-based business clusters.

Air transport infrastructure, taking advantage of the comparative advantages of the region expressed in its natural resources, geographical location and business experience, supports the creation of new jobs, promotion of economic growth, and improvement of the well-being of the population to one degree or another. By supporting competitiveness, air transport infrastructure participates in the formation of a favorable environment for the formation of commercial clusters. The opportunities for the development of the economy in border areas by taking advantage of air transport and its quality infrastructure are in the focus of attention of business entities and management structures [Berezhnaya, 2021]. Studies dedicated to the use of air transport by local business entities [Muna et al., 2023] show that there are real opportunities to take advantage of the comparative advantages of the region, including the corresponding advantages. In our opinion, we can agree with this position.

On the impact of new airports in Azerbaijan on regional development. As can be seen from foreign experience [Phuoc et al., 2025], the state plays a leading role in the construction of air transport infrastructure in the development of post-conflict areas. The use of state investments in the construction of the logistics chain, the impact on the socio-economic development of the region, and the comprehensive and effective allows for management. In the liberated territories of Azerbaijan, in Karabakh and in the East Zangezur economic regions, three new international airports - Fuzuli, Zangilan and Lachin - have been put into operation over the past five years. The new airports serve to accelerate the economic reintegration processes by expanding the logistics capabilities in the regions in question. The infrastructure of these airports, which can accommodate most aircraft, including heavy cargo aircraft, is expected to give a more serious impetus to the rapid restoration and reconstruction of the territories and the acceleration of the reintegration process of the region in the near future. Green infrastructure criteria are given priority in the Karabakh and East Zangezur economic regions. Necessary measures are being taken here to ensure development in accordance with the concept of sustainable development.

As one of the regions of Azerbaijan, the Nakhchivan Autonomous Republic, which has a unique geopolitical position but has had a limited transport corridor for decades, has studied the impact of infrastructure innovations on regional development [Esgerova, 2026]. As shown here, infrastructure innovations contribute not only to economic growth, but also to social cohesion by reducing transaction

costs, accelerating the movement of products and information, and increasing institutional and technological potential. As mentioned above, the fact that the necessary database is still in the formation stage makes it difficult to measure the impact of air transport infrastructure on the socio-economic development of the relevant regions using econometric methods alone. For these and other reasons, studies conducted on the example of the regions of Azerbaijan [Mammadli, 2026] also paid attention to the possibilities of using expert technologies.

Conclusion. The impact of air transport infrastructure on the efficiency of production and resource potential utilization manifests itself in various directions. Air transport infrastructure can make a significant contribution to the transition from the principle of a linear economy to a circular economy in the transformation of the region's resource potential into production potential. Recent studies and the conceptual discussion supported by the example of Azerbaijan give grounds to say that air transport infrastructure can play a serious role in the formation of economic agglomerations as a favorable option for using regional potential. This role will be expressed in the contribution to strengthening the innovation potential, catalytic impact on local initiatives, acceleration of reintegration processes, the region's competitiveness and opportunities to use comparative advantages, and the formation of a sustainable ecosystem. The methodological framework remains largely conceptual, and empirical testing is currently limited due to incomplete data.

Limitations and directions for future research

One of the main factors limiting the study of the impact of air transport infrastructure on the efficiency of using the region's production and resource potential is the incompleteness and lack of representativeness of the database. The methodological framework remains largely conceptual, and empirical testing is currently limited due to incomplete data. For future research, as the necessary database is formed, we consider the study of the impact of green airports on the efficiency of the circular transformation of the region's resource potential into production potential and economic decentralization processes to be a more promising direction.

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