

Study on the Impact of Transport Infrastructure on Regional Economic Development

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Keywords: Transport; Economy; Development

Abstract: This paper provides an in-depth discussion around the definition and classification of transport infrastructure and its role in economic development. As an important support for socio-economic activities, transport infrastructure, including roads, railways, waterways, aviation and urban railways, has its own characteristics and plays an indispensable role in economic development. The article further analyses the impact mechanism of transport infrastructure on regional economic development, pointing out that it promotes economic development by shortening the distance between time and space, improving the efficiency of resource allocation, promoting industrial agglomeration and upgrading, enhancing regional connectivity and improving the quality of life of the residents. At the same time, the article also focuses on the challenges faced in the process of transport infrastructure construction, such as financial, environmental and social issues, and puts forward corresponding countermeasures and recommendations, with a view to providing reference for governments, enterprises and the community in promoting transport infrastructure construction and economic development.

1. Introduction

As an important cornerstone of modern socio-economic development, the level of construction and development of transport infrastructure is directly related to the economic prosperity and social progress of a region or even a country. From the ancient stagecoach routes and canals to the modern highways, high-speed railways and aviation networks, every innovation in the mode of transport has profoundly changed the economic pattern and lifestyle of human society. In today's context of deepening globalization, the importance of transport infrastructure has become even more prominent, not only as a link connecting different regions, but also as a key force in promoting the flow of resources and accelerating economic development. This study aims to delve into the definition and classification of transport infrastructure and its central role in economic development. By meticulously analyzing how transport infrastructure shortens spatial and temporal distances, improves the efficiency of resource allocation, facilitates industrial clustering and upgrading, enhances regional connectivity, and improves the quality of life of the residents, we expect to comprehensively reveal the complex mechanism of transport infrastructure's impact on regional economic development. At the same time, we also pay attention to the many challenges faced in the process of transport infrastructure construction, such as financing, environmental protection and

social impacts, and propose corresponding countermeasures to address these issues.

2. Definition and classification of transport infrastructure

2.1 Define

The definition and classification of transport infrastructure is fundamental to understanding and exploring its impact on economic development. The concept of transport infrastructure needs to be clarified. Transport infrastructure, in short, refers to the various facilities and equipment that provide transport services for socio-economic activities. It is a broad and comprehensive definition that encompasses all the physical infrastructure used to support and facilitate transport activities. These facilities and equipment include, but are not limited to, roads, railways, waterways, aviation, and urban railways, which together form the backbone of the transport network of modern society. The scope of transport infrastructure is broad and covers all fixed facilities used for transport. These facilities are the basis for transport activities and include not only ground transport facilities such as roads, bridges and tunnels, but also water and air transport facilities such as ports and airports. In addition, railway tracks and their related facilities, such as stations and signalling systems, are also an important part of transport infrastructure. Together, these facilities and equipment form a complex and extensive transport network that provides the necessary transport support for the economic activities of the society. Under this definition, transport infrastructure is not just a physical concept, it also encompasses the various services and management systems associated with it. For example, the control system for traffic signals, the distribution system for traffic information, and the system for ensuring traffic safety are all important components of transport infrastructure. These systems and services are interdependent with the physical facilities, and together they provide all-round support for the transport activities of society. Transport infrastructure also has a distinct social and economic nature. It is an important part of socio-economic activities and at the same time an important force in promoting economic development. The level of construction and development of transport infrastructure directly affects the economic prosperity and social progress of a region. Therefore, for the definition and classification of transport infrastructure, we need to understand and explore it in a broader social and economic context [1].

2.2 Classification and characteristics

In the classification of transport infrastructure, we can divide it into road transport, railway transport, waterway transport, air transport and urban rail transport according to its main features and functions. Each type has its unique advantages and applicable scenarios, which together constitute a diversified transport network in modern society. Road transport is famous for its high flexibility and wide coverage. Whether it is for short-distance travel or long-distance transport, road transport plays a vital role. It reaches into every village and city, connecting all corners and making the movement of people and goods extremely convenient. The development of road transport not only promotes the prosperity of regional economy, but also brings great convenience to people's daily life. Railway traffic stands out for its huge transport volume and fast running speed. In terms of long-distance and bulk cargo transport, railway traffic has unparalleled advantages. It can transport large quantities of goods from one place to another at a lower cost and in a shorter time, which is of great significance in promoting the development of regional economy and the prosperity of international trade. In addition, with the continuous development of high-speed railway technology, railway traffic also shows stronger and stronger competitiveness in the field of passenger transport. Waterway traffic is favoured for its low cost and suitability for long-distance transport of bulk goods. However, its development is limited by geographical conditions and needs

to be fully developed in areas with convenient waterways and harbours. Nonetheless, waterway transport still occupies a pivotal position in global trade and regional economy, and is an important link between different countries and regions. Air transport, on the other hand, is highly valued for its speed and suitability for long-distance and international transport. In modern society, air transport has become an indispensable part of international business, tourism and logistics. However, the high cost of air transport compared to other modes of transport has limited its application in certain areas. Nevertheless, with the continuous progress of technology and intensified market competition, the cost of air transport is gradually decreasing and its application scope is expanding [2]. Urban rail transport, on the other hand, is an important means of easing urban traffic pressure and improving the efficiency of intra-city transport. With the acceleration of urbanisation and the continuous growth of population, urban traffic problems are becoming more and more prominent. Urban rail transit is favoured for its fast, convenient and environmentally friendly features, and has become an important support for modern urban development. It can not only effectively alleviate the problem of urban traffic congestion, but also improve the travelling efficiency and quality of life of urban residents.

2.3 Role in economic development

Transport infrastructure plays a crucial role in economic development, and different types of transport modes have distinctive roles in promoting economic development. As the main modes of land transport, road and railway transport play an irreplaceable role in promoting regional economic integration and accelerating the flow of resources and factors. The construction and improvement of road and railway transport networks have not only made the movement of people and goods more convenient, but have also promoted economic ties and cooperation between different regions. Such close economic ties help to break down geographical barriers and promote regional economic integration, thereby realising a wider sharing of resources and complementing each other's strengths. At the same time, the rapid development of road and railway transport has accelerated the flow of resources and factors, providing strong support for economic development. Waterway transport, on the other hand, plays a unique role in supporting international trade and promoting the economic development of coastal and riverine areas. Waterway transport has become an important mode of transport in international trade because of its low cost and suitability for long-distance transport of bulk goods. It connects different countries and regions, facilitates the transnational flow of goods and services, and promotes the prosperity of the global economy. At the same time, the development of waterway transport has also driven the economic development of coastal and riverine areas, which have developed into important economic centres and trade hubs on the basis of convenient water transport conditions. Air traffic is of great significance in enhancing international links and promoting the development of high-tech and high-end service industries. The rapid development of air traffic has made cross-border travel and cargo transport more convenient, strengthening economic ties and cultural exchanges between different countries. Such close international ties help to promote cross-border investment, trade and technical cooperation, thereby contributing to the prosperity of the global economy. At the same time, the development of air transport also provides a broad space for the development of high-tech and high-end service industries, which have achieved rapid development and expansion by relying on convenient air transport conditions. Urban rail transport, on the other hand, plays an important role in optimising the spatial layout of cities and enhancing their competitiveness. With the acceleration of urbanisation and the continuous growth of population, the problem of urban transport is becoming more and more prominent. With its fast, convenient and environmentally friendly features, urban rail transit has become an important means to solve urban traffic problems. It can not only effectively alleviate the problem of urban traffic

congestion, improve the travel efficiency and quality of life of urban residents, but also optimise the urban spatial layout and promote the balanced development of urban economy. At the same time, the development of urban rail transport also enhances the overall competitiveness of the city, making the city more advantageous in attracting investment, talent and tourism.

3. Mechanisms for the impact of transport infrastructure on regional economic development

3.1 Bridging the gap between space and time

As the backbone of modern economic and social development, the construction and improvement of transport infrastructure has an inestimable impact on shortening the physical distance between regions and accelerating the flow of people, goods and information. This mechanism has not only profoundly changed the regional economic pattern, but also greatly promoted the overall development and progress of society. The construction of transport infrastructure directly shortens the physical distance between regions. The establishment of modern transport systems such as highways, high-speed railways and aviation networks has made the once out-of-reach cities and villages and regions within reach. Taking high-speed railway as an example, with its high-speed and punctual characteristics, it has greatly shortened the travelling time between cities and made the "same-city effect" possible. People can travel between different cities in a shorter time for business activities, cultural exchanges or leisure travel, thus strengthening inter-regional ties and cooperation. The improvement of transport infrastructure accelerates the flow of people. Convenient transport conditions make it easier for people to migrate and move between different regions, whether for work, study or life. Such mobility not only promotes the rational allocation of human resources, but also injects new vigour into regional economies. For example, some underdeveloped regions have attracted a large number of migrant workers and entrepreneurs by improving their transport conditions, thus boosting the development of the local economy [3]. At the same time, the flow of people also promotes the exchange and integration of culture, ideas and technology, laying the foundation for the diversified development of regional economy. The flow of logistics is also accelerated by the improvement of transport infrastructure. The development of the modern logistics industry is highly dependent on an efficient transport network. Transport facilities such as highways, railways, ports and airports provide a strong guarantee for the rapid transport of goods. By optimising the layout of the logistics network and improving transport efficiency, enterprises can respond faster to market demand, reduce operating costs and enhance competitiveness. In addition, the accelerated flow of logistics also promotes inter-regional economic complementarity and synergistic development, enabling each region to give full play to its own advantages and achieve the optimal allocation of resources. The improvement of transport infrastructure also accelerates the flow of information. In the information age, the speed of information dissemination directly determines the speed and quality of economic development. And the construction of transport infrastructure provides a physical basis for the rapid dissemination of information. Through the construction of a wide-coverage, technologically advanced communication network, people can obtain and share all kinds of information in real time, providing powerful support for economic decision-making and market forecasting. At the same time, the improvement of transport infrastructure also provides a broad space for the development of e-commerce, distance education and other emerging businesses, further promoting the digital transformation and upgrading of the regional economy.

3.2 Improving the efficiency of resource allocation

Improving the efficiency of resource allocation is one of the important goals of economic

development, and the improvement of transport conditions plays a crucial role in this process. By reducing transport costs, improved transport conditions not only directly reduce logistics costs, but also significantly enhance the market competitiveness of products. At the same time, it promotes the improvement of market efficiency, so that resources can flow more quickly to areas of high demand, greatly improving the market response speed. Reduced transport costs are a direct economic benefit of improved transport conditions. Good transport infrastructure can reduce time delays and losses in the logistics process and lower the cost of transporting goods. This is not only a boon for production enterprises, because they can invest more money in product development and quality control, rather than being swallowed up by high logistics costs; at the same time, for consumers, it also means that they are able to buy more affordable and quality-assured goods. Therefore, improving transport conditions lays a solid foundation for enhancing the market competitiveness of products by reducing transport costs. In addition to reducing transport costs, improved transport conditions also greatly contribute to market efficiency. In an easily accessible environment, resources can flow more quickly from one place to another, especially to those areas of high demand. This rapid flow of resources not only helps to meet immediate market demand, but also reduces waste due to resource mismatch. For example, when a region is suddenly hit by a natural disaster, improved transport conditions can allow relief supplies and reconstruction materials to reach the affected area quickly, thus minimising the damage caused by the disaster. Similarly, in the commercial sector, the rapid flow of resources means that enterprises are able to seize market opportunities more quickly and adjust their production strategies to meet the changing needs of consumers. In addition, improved transport conditions can also help promote balanced regional economic development. In the past, due to inconvenient transport, some regions, despite having abundant resources, found it difficult to turn them into a driving force for economic development. Nowadays, with improved transport conditions, these regions can more easily connect with external markets and attract more investment and talents. This not only helps to enhance the local economy, but also promotes the economic integration process of the entire region [4].

3.3 Promoting industrial agglomeration and upgrading

Improvements in transport infrastructure play a crucial role in promoting industrial agglomeration and upgrading. Through the optimisation of industrial layout, the improvement of transport infrastructure has attracted many enterprises to gather in a particular area, forming an industrial cluster effect. This clustering effect further promotes technological innovation and industrial upgrading, and promotes the sustainable and healthy development of the economy. The improvement of transport infrastructure provides strong support for the optimisation of industrial layout. The convenience of a region's transport directly affects the operating costs and market accessibility of enterprises. Therefore, when the transport infrastructure of a region is significantly improved, it tends to become a hot spot for corporate investment. Firms tend to set up production bases or R&D centres in regions with good access to supply chains, distribution networks and talent markets. This tendency has led to the clustering of firms in specific areas, forming clusters with distinctive characteristics. For example, high-tech firms may tend to cluster in cities with advanced communication networks and easy access to international transport, while manufacturing firms may value ease of logistics and transport. Industrial clustering not only brings about economies of scale, but also promotes technological innovation and industrial upgrading. Within industrial clusters, close co-operation and competition among firms stimulate innovation. Enterprises can more easily share resources, exchange experiences and engage in technical cooperation, thus accelerating the R&D process of new products and technologies. At the same time, enterprises within industrial clusters also face more intense market competition, which forces them to continuously upgrade their

technical level and product quality. In this environment, industrial upgrading has become an inevitable trend. Enterprises enhance their market competitiveness by introducing advanced technologies, optimising production processes and improving product quality, thus promoting the upgrading and development of the whole industrial cluster. The improvement of transport infrastructure also provides a broader market space for industrial clustering and upgrading. Convenient transport conditions make it easier for enterprises to expand domestic and foreign markets and obtain more customer resources. At the same time, the improvement of transport infrastructure also promotes the flow and agglomeration of production factors such as talents, information, capital, etc., which provides richer resource support for industrial clustering and upgrading.

3.4 Enhancing regional connectivity

Improvements in transport infrastructure play a crucial role in enhancing regional connectivity, not only by facilitating interregional trade and investment activities, but also by promoting the formation of wider economic cooperation zones and laying a solid foundation for regional economic integration.

Improved transport has greatly strengthened inter-regional economic ties. Convenient transport conditions have enabled goods, services and factors of production to move more quickly and efficiently between different regions. This provides enterprises with a broader market space, making it easier for them to expand their business, find partners and achieve optimal allocation of resources. At the same time, improved transport also reduces logistics costs and increases the competitiveness of products, further promoting inter-regional trade activities. Investors are also more inclined to invest their capital in areas with convenient transport in order to obtain a better return on investment. Therefore, the improvement of transport infrastructure provides strong support for inter-regional economic cooperation and development. In addition to strengthening economic ties, transport improvements also promote the process of regional integration. In areas with easy access to transport, the boundaries between cities and villages and between different administrative regions become blurred and are replaced by closer economic ties and cooperation. This trend has facilitated the sharing and allocation of resources, technology, talent and other factors of production on a wider scale, providing favourable conditions for regional economic integration. At the same time, improved transport has also made it easier for policymakers to implement uniform economic policies and management measures across different regions, further facilitating the process of regional integration. Regional integration has led to the formation of larger economic cooperation zones. Regions within these economic cooperation zones enjoy closer economic ties and cooperation mechanisms to jointly address market challenges and promote industrial upgrading and innovative development. For example, some countries have strengthened their economic ties and cooperation with neighbouring countries through the construction of cross-border highways, railways and other transport infrastructure, resulting in the formation of cross-border economic cooperation zones. These economic cooperation zones have not only facilitated the free flow of goods and services, but also promoted exchanges and cooperation in terms of personnel, culture and technology, injecting new vitality into the prosperity and development of regional economies. Improved transport infrastructure plays a pivotal role in enhancing regional connectivity. It not only strengthens inter-regional economic ties and trade and investment activities, but also promotes the process of regional integration and the formation of wider economic co-operation zones. Therefore, we should continue to increase investment in and construction of transport infrastructure in order to further optimise the structure of regional connectivity and promote sustained and healthy economic development [5].

3.5 Enhancing the quality of life of residents

The improvement of transport infrastructure plays a crucial role in enhancing the quality of life of residents. It not only greatly improves the convenience of travelling for the residents, but also brings better employment opportunities and services to the residents, thus enhancing their overall quality of life. At the same time, the construction of transport infrastructure itself also creates a large number of employment opportunities, further promoting the economic development of society. The enhancement of residents' travelling convenience as a result of improved transport conditions is obvious. With the continuous improvement of roads, public transport, railways and other transport infrastructure, the time and economic costs of travelling for residents have been significantly reduced. They can reach their destinations more quickly and enjoy a more convenient and comfortable travelling experience, whether for work, school or leisure. In addition, improved transport conditions also enable residents to have easier access to a wider range of social resources, such as education, healthcare and culture, further enriching their lives. Improved transport accessibility also brings better employment opportunities and services to residents. In areas with convenient transport, businesses are more likely to attract high-calibre talent, as employees can commute more easily, reducing the loss of labour due to transport inconvenience. At the same time, transport accessibility also promotes the development of commercial and service industries, providing residents with more diversified employment options. In an environment with abundant employment opportunities, residents can more easily find jobs that suit them and realise both personal value and social contribution. In addition, transport convenience also enables residents to enjoy higher-quality services, such as medical care, education and entertainment, and the enhancement of these services directly improves their quality of life. The construction of transport infrastructure itself also creates a large number of employment opportunities. In the process of transport infrastructure construction, a large number of engineers, technicians and construction workers are needed. These employment opportunities not only provide a source of income for local residents, but also promote the development of related industries, such as construction, manufacturing and so on. Meanwhile, the improvement of transport infrastructure also attracts more enterprises and investors to the region, further promoting economic prosperity and development. Under such an environment, residents can more easily find stable jobs and achieve economic independence and stability of life. In addition to direct employment opportunities, improvements in transport infrastructure also bring indirect economic benefits [6]. For example, transport convenience allows residents to have easier access to external markets, which promotes the sale of agricultural products and the development of the rural economy. At the same time, accessibility also attracts more tourists to the area, boosting tourism and providing local residents with more employment opportunities and sources of income.

4. Challenges and responses

4.1 Challenges to be faced

In the course of promoting the construction of transport infrastructure, we are faced with challenges in many aspects, including mainly financial problems, environmental problems and social problems. Financing is a major challenge in transport infrastructure construction. Such projects usually require huge investments, including land acquisition, material procurement, construction and equipment purchase, and each of these requires a large amount of financial support. However, the limited and uncertain sources of funding often hinder project progress. Government financial allocations, bank loans, and social capital inputs are all common sources of funding, but in practice, how to balance the interests of all parties and ensure that the funds continue to be invested

in a stable manner is a complex and thorny issue. Environmental issues are also challenges that cannot be ignored in the process of transport infrastructure construction. The construction process may cause certain damage to the environment, such as land excavation, destruction of vegetation and pollution of water sources. These environmental problems not only affect the local ecological balance, but may also pose a threat to the quality of life and health of the residents. Therefore, while promoting the construction of transport infrastructure, it is necessary to give full consideration to the factor of environmental protection and take effective measures to reduce the impact on the environment. Social issues are also an important aspect that requires attention in the process of transport infrastructure construction. Issues such as land acquisition and relocation of residents often involve complex interests and social conflicts. On the one hand, the government needs to ensure the smooth progress of the project, and on the other hand, it also needs to give due consideration to the interests and demands of the residents. If not handled properly, social conflicts and contradictions may arise, affecting project implementation and social stability. In the face of these challenges, we need to take practical and effective countermeasures to deal with them. For the funding problem, we can solve it by diversifying financing channels, optimising the investment structure and improving the efficiency of capital use. At the same time, the government should also increase investment in transport infrastructure construction to provide a strong guarantee for the smooth implementation of the project.

4.2 Recommendations for countermeasures

In the face of the challenges posed by the construction of transport infrastructure, we need to put forward practical countermeasures and recommendations at three levels, namely, the Government, enterprises and the community, so as to ensure the smooth implementation of projects and social harmony and stability. At the government level, formulating long-term planning is the first and foremost task. The government needs to take a holistic view of the overall situation and carry out long-term planning and layout of transport infrastructure construction, so as to ensure that the projects are in line with the needs of economic and social development. At the same time, the government should also provide the necessary financial support and policy guidance to provide a stable source of funding and a favourable policy environment for transport infrastructure construction. This can not only reduce the investment pressure on enterprises, but also reduce the financing cost of the project and improve the economic and social benefits of the project. At the enterprise level, encouraging technological innovation is the key to improving construction efficiency and quality. Transport infrastructure construction is a technology-intensive industry that requires the constant introduction of new technologies, processes and materials to improve construction efficiency and quality. The government can encourage enterprises to carry out technological innovation and research and development by providing financial support for scientific research and establishing a mechanism for co-operation between industry, universities and research institutes. At the same time, enterprises should also actively co-operate with domestic and foreign scientific research institutions to jointly overcome technical problems and promote technological progress and industrial upgrading in transport infrastructure construction. In addition to technological innovation, enterprises should also focus on management innovation. By introducing advanced management concepts and methods, optimising the project management process and improving the level of project management, they can further reduce construction costs and improve construction efficiency and quality. In addition, enterprises should also strengthen talent training and team building, improve the professional quality and working ability of employees, and provide strong talent protection for transport infrastructure construction. At the social level, strengthening public participation is an important way to ensure project transparency and sustainability. Transport

infrastructure construction involves the interests of the general public, so it is necessary to fully listen to public opinions and suggestions to ensure that the decision-making process of the project is open and transparent. The government can strengthen communication and interaction with the public by establishing a public participation mechanism and conducting public consultation activities. At the same time, the media should also play an active role in monitoring and reporting on transport infrastructure construction in an objective and fair manner, so as to enhance the social awareness and credibility of the project. To ensure the sustainability of transport infrastructure construction, we also need to focus on environmental protection and social responsibility. In the process of project construction, environmental protection regulations should be strictly observed and effective measures should be taken to reduce the impact on the environment. At the same time, enterprises should also actively fulfil their social responsibilities, pay attention to the development needs of the local community, and provide necessary help and support to local residents. In the face of the challenges posed by transport infrastructure development, we need to formulate practical countermeasures and proposals from the three levels of government, enterprises and society. The government needs to formulate long-term plans and provide financial support and policy guidance; enterprises need to encourage technological innovation and improve the efficiency and quality of construction; and society needs to strengthen public participation and ensure the transparency and sustainability of projects. Through the implementation of these countermeasures, we can effectively address the challenges faced by transport infrastructure development, and promote the smooth implementation of projects and social harmony and stability. At the same time, we can also provide useful lessons and references for future transport infrastructure construction and promote the sustainable and healthy development of transport.

5. Conclusion

Transport infrastructure, as a variety of facilities and equipment providing transport services for socio-economic activities, covers a wide range of aspects such as roads, railways, waterways, airways and urban railways, which have their own characteristics in terms of flexibility, capacity, speed and cost, and which together form the cornerstone of the national transport network. Transport infrastructure plays a pivotal role in economic development. It not only promotes regional economic integration and accelerates the flow of resources and factors, but also supports international trade and promotes the economic development of coastal and riverine areas. At the same time, transport infrastructure also enhances international links, promotes the development of high-tech and high-end service industries, and optimises the spatial layout of cities to enhance their competitiveness. The impact mechanism of transport infrastructure on regional economic development is mainly reflected in shortening time and space distances, improving resource allocation efficiency, promoting industrial agglomeration and upgrading, enhancing regional interconnection and improving the quality of life of residents. It accelerates the flow of people, logistics and information, expands the market scope, reduces transport costs, promotes market efficiency, optimises industrial layout, promotes regional integration, and improves the convenience of travel and quality of life of residents, thus comprehensively promoting the development of regional economy. However, the construction of transport infrastructure also faces multiple challenges, including financial, environmental and social ones. To address these challenges, we need to formulate practical countermeasures and proposals from the three levels of government, enterprises and society. The government needs to formulate long-term plans and provide financial support and policy guidance; enterprises need to encourage technological innovation to improve construction efficiency and quality; and society needs to enhance public participation to ensure project transparency and sustainability. Through the implementation of these countermeasures, we

can effectively address the challenges facing transport infrastructure construction, promote the smooth implementation of projects and social harmony and stability, and lay a solid foundation for future transport and economic development.

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