Research on the relationship between transportation facilities and economic growth in Shanxi Province

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Abstract. There is a saying in China, "If you want to get rich, build roads first." This sentence points out the relationship between transportation facilities and economic development. The operating mileage of railways, highways and other modes of transportation represents a region's transportation development, and they are inseparable from economic development. This article analyzes the traffic problems in Shanxi Province and related economic development problems based on the railway operating mileage and highway mileage in Shanxi Province in the past ten years. The study found that the mileage of railways and highways has a positive correlation with GDP. Then through the establishment of a regression model, the linear relationship between the three is determined, and finally based on the relationship between the three, suggestions suitable for the transportation and economic development of Shanxi Province are put forward.

1. Introduction

Shanxi Province is a major coal province. It is located in North China, surrounded by Hebei, Henan, Shaanxi, and Inner Mongolia. It has a very important strategic position. It has obvious economic advantages. It is the main support point of Chinese strategy of "carrying coal from the north to the south" and "carrying coal from the west to the east". However, in 2020, Shanxi Province’s GDP is 1,765 billion yuan, ranking only 21st among all provinces in the country. In order to explain the reasons for the backward GDP of Shanxi Province in terms of transportation, the following research was done.

2. Journals reviewed

There has always been no shortage of research on the relationship between transportation and economic growth. The existing conclusions show that transportation infrastructure has a positive effect on the economy, but most of them analyze the impact of overall transportation facilities or transportation investment on the economy, such as Junchao Wang's research The coupling of transportation and regional economy in the urban agglomeration of the Yangtze River Delta.[1] Chunyang Wang, Weidong Meng, Xinshuo Hou studied the impact of high-speed rail on urban economy.[2] Ying Guo, Biao Li, Yilong Han studied the coupling of railway and economy relationship.[3] There are relatively few studies on the relationship between transportation and economy in specific regions. Zhou Xiyi and others used linear regression models to study the correlation between railway transportation construction and economic development in Sichuan Province.[4] Ma Yuan qualitatively analyzed the relationship between Jincheng’s regional economy and comprehensive transportation development, but this article is more inclined to the requirements and impact of the economy on transportation facilities. Point out the impact of transportation facilities on the economy.[5]
However, different regions have different resources and backgrounds, and the overall research of others may not be suitable for every region. In order to solve the "bottleneck" in the development of Shanxi Province, this paper studies the main economic industries and transportation network of Shanxi Province, and makes suggestions for the problems.

3. Background and methods
Shanxi Province is located in North China, surrounded by Hebei, Henan, Shaanxi, and Inner Mongolia. Has a very important strategic position. Shanxi Province is a large coal province. Coal is transported to all directions by railway. It is the main support point of China's "North-South Transportation of Coal" and "West-East Coal Transportation" strategy. The railway lines passing through Shanxi include Daqin Line (Datong to Qinhuangdao), Jingbao Line (Beijing to Baotou), Jingyuan Line (Beijing to Yuanping), Shenhuang Line (Shenchi to Huanghua), Taijiao Line (Taiyuan to Jiaozuo), etc. Many railways. In terms of highways, Shanxi Province includes the "three verticals, twelve horizontals and twelve ring roads", which connect all cities in the province and connect with other provinces through Qinglan Expressway (Qingdao to Lanzhou) and Qingyin Expressway (Qingdao to Yinchuan). Connecting Hebei, Shanxi, and Shaanxi provinces, connecting Hebei, Shanxi, and Inner Mongolia via Rong-Wu Expressway (Rongcheng to Wuhai), Er-Guang Expressway (Erlianhot to Guangzhou), Jingkun Expressway (Beijing to Kunming) connecting Inner Mongolia, Shanxi and Henan vertically connection.

It can be seen from the above that the existing transportation facilities in Shanxi Province are relatively comprehensive. In fact, in recent decades, Shanxi’s transportation network has expanded, and the number of railway and highway operating mileage has increased year by year. According to the statistics of Shanxi Bureau of Statistics, from 2010 to 2019, Shanxi’s railway operating mileage has increased by about 2,138 kilometers. The mileage has increased by about 12,639 kilometers, the specific trend chart is as follows:

![Fig 1. The length of railway and highways](image)

In addition, according to the statistics of Shanxi Bureau of Statistics, in addition to the increase in the number of roads and railways, the gross domestic product is also showing an upward trend.

![Fig 2. The GDP of Shanxi province](image)
3.1 Correlation coefficient analysis
Through observation, it is found that the GDP of Shanxi Province has a similar trend with the operating mileage of railways and highways in Shanxi Province. Therefore, it is assumed that the number of railway mileage and highway mileage are related to GDP. In order to verify this assumption, the correlation coefficient method is used to calculate its correlation coefficient, the formula is as follows:

\[ r(A, B) = \frac{\text{Cov}(A, B)}{\sqrt{\text{Var}A \times \text{Var}B}} \]  

(1)

In the formula (1), A and B are two variables respectively, namely the number of railway operating mileage and the number of highway mileage, Cov (A, B) is the covariance between the two variables, and VarA and VarB are the variances of the variables respectively.

Through calculation, the correlation coefficient \( r_1 \) between road mileage and GDP is 0.867, and the correlation coefficient \( r_2 \) between railway operating mileage and GDP is 0.789. Therefore, the total road mileage and the total railway operating mileage from 2010 to 2019 are calculated separately from GDP. It is found that both have a significant positive correlation with GDP.

3.2 Linear regression analysis
In order to specifically describe the relationship between railway and highway operating mileage and GDP, multiple regression analysis is selected for calculation. The formula is as follows:

\[ y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \epsilon \]  

(2)

In the formula, \( y \) is GDP, \( x_1 \) is railway operating mileage, \( x_2 \) is highway operating mileage, and \( \epsilon \) is the random disturbance item.

Through calculation, the results are as follows:

| Table 1. ABSTRACT |
|-------------------|
| R                | \( R^2 \) | Adjusted \( R^2 \) |
| 0.871            | 0.759    | 0.691          |

| Table 2. ANOVA |
|----------------|
| Unstandardized coefficient | Standardized coefficient \( \beta \) | \( t \) | Significance |
|-------------------|----------------|-----------------|---------------|
| Constant          | -51321.28     | -1.911          | 0.098         |
| Length of Railway in Operation | 0.471        | 0.163           | 0.445         | 0.670 |
| Length of highways | 0.442         | 0.727           | 1.992         | 0.870 |

Dependent variables: GDP of Shanxi Province

It can be drawn from the results of data analysis

\[ y = -51321.28 + 0.163x_1 + 0.727x_2 + \epsilon \]  

(3)

In the result, the adjusted \( R^2 \) value is 0.691, indicating that the railway and highway mileage of Shanxi Province can explain 69.1% of its GDP change. Formula (3) indicates the linear relationship between the operating mileage of railways and highways in Shanxi Province and its GDP development.

Based on the relationship between the three, the following suggestions are made

4. Analysis and suggestion

4.1 The transportation construction of Shanxi Province should be adapted to the economic development
The mileage of roads and railways has a positive correlation with the economy. The increase in the mileage of roads and railways in operation requires state investment and economic support. Therefore,
the construction of roads and railways must be subordinated to the economic development of the society and coordinated with the distribution of regional productivity and economic capabilities.

For Shanxi Province, the number of railways has a greater impact on the economy than the number of highways. Therefore, more attention should be paid to the development of railways. Railways have natural advantages in transporting coal. At the same time, the improvement of high-speed rail lines is also conducive to Shanxi. The development of tourism in the province,

4.2. The economy can be developed by increasing highway mileage
The increase in highway mileage can increase the freight capacity of highways, directly provide economic growth, and can also promote the development of other industries, such as trade, agriculture, and tourism, thereby indirectly promoting economic development.[6]

However, the connection between Shanxi Province and neighboring provinces is limited. There are fewer roads and railways in the north-south direction, especially the coal-transporting railway line, which cannot well support my country's "North-to-South coal transportation" strategy. Most of the railways in the east-west direction are concentrated in Shanxi. The northern and central parts, while the southern part has fewer routes, should establish a more complete and developed transportation system to transport coal to various places smoothly and conveniently.

4.3 The traffic burden can be reduced by changing the structure of the economy
The focus of transportation services should be shifted from a coal economy to a whole industry economy. The structure that uses coal as the main source of income can no longer meet the needs of rapid development.

For a long time in the past, coal has been the main source of income in Shanxi Province. According to statistics, as of 2021, Shanxi Province has a total of 880 coal mines, all of which are located in almost every region of Shanxi Province. The strength of the coal economy, on the one hand, has made important contributions to the economic development of Shanxi Province. On the other hand, the single industry has not only challenged certain modes of transportation, namely railways and highways, but also restricted it to a certain extent due to investment reasons. The development of other industries, therefore, it is recommended that Shanxi Province increase the development of other types of industries besides coal, such as tourism, planting, and so on.

5. Summary
From the perspective of transportation facilities to promote economic development, on the one hand, it can directly promote economic development by increasing the mileage of railways and highways in Shanxi Province. The development of the transportation network is conducive to reducing the transportation costs of enterprises and enabling the rapid circulation of commodities, thereby achieving the benefits of directly increasing profits, such as the transportation of coal. On the other hand, economic development can be promoted indirectly through the transportation system. The improvement of transportation infrastructure can promote the joint development of various provinces and produce a regional economic effect of "1+1>2". The accessibility of the transportation network can attract more companies to settle in the local area, thereby driving employment and consumption.

From the perspective of economic impact on the improvement of the transportation network, investment in railway-based transportation facilities can be increased. Shanxi is an important link connecting Shaanxi, Inner Mongolia, Hebei, and Henan. It is the main support point of China's "North-South Coal Transportation" and "West-East Coal Transportation" strategy. It is the intersection of my country's north-south vertical and east-west horizontal lines. In order to "connect the north and the south, open up the east and west", Shanxi Province should increase the strength of connection with neighboring provinces, base on the overall situation of national and regional economic development, strengthen the linkage between provinces, and improve the level of economic development, thereby boosting Development of transportation infrastructure. In addition, almost all existing transportation routes in our country are government investment. This article believes that enterprises and social investment should
be encouraged and attracted to jointly participate in road construction, and then given certain priority rights of passage within a certain period of time. The introduction of social capital can reduce the government's financial burden and improve social public benefits.

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