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Analysis of Influencing Factors of Shanxi Economic Development based on Multiple Linear Regression Analysis

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Abstract

Based on the provincial economic development, this paper uses the method of multiple linear regression analysis to analyze the relevant indicators of Shanxi Province from 1996 to 2017, and obtains the important factors influencing the GDP of Shanxi Province under the new normal. The results show that the employment rate and urbanization of Shanxi Province have important influence on the economic development of Shanxi Province under the new normal economy. The following suggestions are put forward: First, to implement the strategy of rural revitalization and steadily promote the process of urbanization; Second, to implement the tourism strategy and create more jobs; and third, to promote the in-depth development of the coal industry and to provide a platform for the re-employment of coal workers.

Keywords

Linear Regression; Economic Development; Influencing Factors.

1. INTRODUCTION

In recent years, with the development of energy saving and emission reduction, the high quality economy development has risen to the national strategic level, and the development mode relying on the consumption of resources for economic growth has been difficult to continue. On January 5,2017, the State Council issued a notice on the issuance of a comprehensive work plan for energy conservation and emission reduction in the 13th Five-Year Plan, which further requires all regions and departments to refrain from relaxing and slackening their efforts in energy conservation and emission reduction, and to maintain unity of thought and action with the decision-making arrangements of the Party Central Committee and the State Council.

Shanxi Province, with its unique coal resources, seized the opportunity to develop the coal industry, from 2002 to 2015, the total economic volume continued to expand, but with the development of new energy industry and the enhancement of residents' awareness of green environmental protection, excessive mining and unreasonable utilization of coal resources gradually dried up, the continuous deterioration of the ecological environment has a negative impact on the economic development environment. The unreasonable economic development model of "A coal dominant" gradually restricts the development of Shanxi Province [1]. Although Shanxi Province made it clear in 2017 that it would basically complete the economic transformation by 2030, many resource-based enterprises have not reached their expectations . In view of the situation that the economic development mode of Shanxi Province needs to be changed urgently and the industrial structure still needs to be optimized, this paper explores the important influencing factors of Shanxi Province's economic development, and puts forward

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practical suggestions in combination with the actual situation, which has certain reference value for Shanxi Province to realize the economic transformation and upgrading.

At present, domestic scholars have studied the influencing factors of Shanxi's economic development from different angles and using different methods, and the conclusions are also different. By analyzing the time and spatial evolution characteristics of Shanxi's rural economic development level by using the coefficient of variation of statistical index and the global spatial autocorrelation Moran index, Yu Qi concluded that technology application, human resources, industrial structure, financial development level, infrastructure condition and fixed investment have important influence on the economic development of Shanxi's rural areas [2]. Tian Yurong, by analyzing different growth modes and Marx's economic viewpoint, thinks that the factors that affect economic development are mainly hard factors and soft factors such as culture, science and technology, innovation, etc. And the role of soft factors gradually highlight [3]. Zhang Yue thinks that Internet development plays an important role in Shanxi's economic development by constructing regression model, among which the most important influencing factors are capital and labor force [4]. Shi Aisheng believes that the unreasonable industrial structure, the lack of stamina in the growth of enterprises due to the unreasonable ownership structure, and the lack of funds due to the poor investment environment are the main factors affecting and restricting the economic development of Shanxi Province[5]. Shi Yangjun believes that the main factors affecting the economic development of Shanxi Province include natural endowment, central government, local government, regional micro-main body and so on [6] . Xue Baogui believes that the reason for the bottleneck of Shanxi's economy lies in the scientific and technological talents, industrial structure and ownership structure [7]. Zhao Xiaolei believes that the main factors affecting the coordinated development of Shanxi Province are natural foundation, economic base and industrial structure [8].

The above-mentioned literature results are of great value for the study of influencing factors of Shanxi's economic development, but some of them have the disadvantages of single research direction, insensitive selection of indicators and reduced accuracy of coverage. Therefore, according to the present situation of Shanxi Province's economic development, starting from five main factors, such as industrial structure, investment in fixed assets, financial expenditure, unemployment rate and urbanization rate, seven indexes affecting Shanxi Province's regional economic development are selected, and based on the relevant index data of Shanxi Province from 1996 to 2017, the multivariate linear regression model is established to analyze the correlation of the factors affecting Shanxi Province's economic development. Put forward practical opinions in combination with practice, and provide certain theoretical basis for Shanxi Province to realize economic transformation and healthy and sustainable development.

2. ECONOMIC DEVELOPMENT IN SHANXI PROVINCE

2.1. Evolution of Economic Development in Shanxi Province

Much of the focus of Shanxi's economic development is on energy industry and infrastructure. In 1980s, Shanxi took the coal energy chemical industry as the leading, vigorously builds the energy chemical industry base. In the 1990s, the initial industrial structure adjustment began, but the economic development thought of the whole province changed little, the transformation and upgrading of the leading industrial structure and the construction of infrastructure have not been given due attention and investment, resulting in a slowdown in the speed of economic development. At the end of the 20th century and the beginning of the 21st century, we began to focus on the strategic adjustment of economic structure and the cultivation of new economic growth points. Sustainable development, developing circular economy and strengthening ecological construction became the goal of Shanxi coal industry in 2010. In recent years, the State Council has designated Shanxi Province as the experimental area for comprehensive

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reform of resource-based economic transformation, focusing its work on deepening supply-side reform and comprehensive reform of transformation, firmly taking the road of "reducing, superior and green" reform, and enhancing the "gold content, new content and green content" of economic development.

2.2. Results of Economic Development in Shanxi Province

In the process of upgrading from the big province of energy and chemical industry to the big province of recyclable economy, the innovation demonstration effect of Shanxi Province is constantly highlighted. With the improvement of the level of economic, the single economic development model, which is dominated by extensive mining and primary energy processing, is difficult to meet the requirements of the country's high-quality economic development. According to its own development status, Shanxi Province has actively promoted industrial structure optimization and upgrading, accelerated supply-side structural reform, vigorously developed tourism and other tertiary industries, and developed the digital economy. The total economic volume reached a new level of 160 billion in 2018, and the speed of economic growth increased steadily; the three industries worked together to optimize the supply structure.

Infrastructure investment is increasing, transportation, post and telecommunications, mobile phones, Internet communications and other infrastructure shortcomings have been filled to varying degrees. The total investment in infrastructure construction in Shanxi Province is 246.3.03 billion yuan, of which the construction of transportation facilities has achieved remarkable results, forming a regional development model of the "point-axis" layout framework; what is more, post and telecommunications is developing and internet coverage is increasing ,and 9.91 million households in the province have installed broadband for up to 2018.

The degree of opening to the outside world has improved significantly, the cooperation space has been expanded, the depth of cooperation has been increasing, and the pattern of export-oriented economy has begun to appear. Imports and exports increased from $1.45 million in 1949 to $20.77 billion in 2018, trading with 27 countries on five continents. At the same time, the implementation of "going out" and "bringing in ", the cumulative use of foreign capital of $384.01 billion, comprehensive expansion of high-tech business.

2.3. Problems in Shanxi Province's Economic Development

(1)The industrial structure still needs to be optimized and the economic transformation and development are difficult. First ,10 of the 11 cities are listed as resource-based cities ,94 of the 119 counties in the province are coal-producing counties, and the industrial pattern of "A coal dominantl" is still there. Second, in industrial enterprises, the state sector accounts for a large proportion of the economy, while the non-public sector accounts for a relatively small proportion,which leads to the vitality and staying power of economic development are insufficient. Third, the development of high-tech industry lags behind, the talent resources are insufficient, the scale is less, the investment intensity is not enough. The simplification of industrial structure leads to the low ability to resist risks, weak industrial connection, low externality and scale effect, which restricts technological progress and industrial optimization level, which hinders the development to the direction of multiple integration. In the economic downturn, the economic decline of the coal industry directly affects the employment and life of residents [9].

(2)The deterioration of the natural environment hinders introduction of investment and talent. Beacause of a large number of coal mining operations, the original land or forest is destroyed, the balance of the ecosystem is broken. And long-term mining will cause water pollution, air pollution, land pollution. First, extensive mining caused no attention to environmental protection during the mining period, the original vegetation and soil were not preserved and reused, the coal mining and loading and unloading process was too rough,

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polluted water resources and land resources; the end of the mining did not do a good job of mountain landfill, vegetation cover and environmental repair in time, resulting in a decline in groundwater level, serious soil pollution,and slow or even difficult ecosystem recovery . Second, because of the weak awareness of environmental protection, the lack of supervision and management departments, the backwardness of pollution gas filtration and treatment technology, and the protection behavior of local governments, the phenomenon that coal smelting plants and other chemical industries emit largeamount of pollutants such as carbon dioxide, sulfur dioxide and respirable particulates is still remains . The secondary pollution, such as acid rain, causes losses to agriculture, other industries and service industries, damages the image of the city, and hinders investment and talent introduction [10].

3. THEORETICAL ANALYSIS OF INFLUENCING FACTORS OF SHANXI ECONOMIC DEVELOPMENT

Economic development is influenced by many factors, including consumption, investment, import and export, employment, and more generally, the of national policy environment, infrastructure, human resources, natural endowment, science and culture education, industrial structure, government behavior ability and so on [11]. There are also many indicators to measure the level of economic development of a region, including employment rate, urbanization rate, industrial structure, regional openness, economic growth rate and other indicators. Combining with the present situation of Shanxi's economic development, it is very important to select the index with significant influence to analyze.

3.1. Industrial Structure

Industrial structure refers to the proportion of agriculture, industry and service industry in a country's economic structure. According to the order of the historical development of social production activities, industries can be divided into agriculture, industry and other industries, corresponding to the primary, secondary and tertiary industries, respectively. Changes in industrial structure provide opportunities for some industries and pose potential threats to other industries. The production mode of each industry is different, the contribution to economic development is also different, the corresponding regional economic industrial structure is different, the economic growth rate and level are also different. As a result, the proportion of industrial added value to GDP plays an important role in explaining the economic factors.

3.2. Social Investment in Fixed Assets

The whole society fixed assets investment is the monetary expression form of constructing and purchasing fixed assets activities, which promote the social fixed assets regeneration. The establishment and development of emerging departments, the development and introduction of advanced science and technology, the upgrading and installation of machinery and equipment can not be separated from fixed assets. The introduction of new technology, the establishment of new departments and the rise of new industries play an important role in adjusting the structure of economic development, creating new economic growth points and promoting the development of high quality and high level of economy, which is an important index to measure the level of modernization of regional economic development.

3.3. Fiscal Expenditure

Fiscal expenditure is the embodiment of the government's function as the executive organ of state power. Raising funds through various forms is applied to capital expenditure, economic construction expenditure, science, education, culture and health expenditure, support for agriculture expenditure, social security expenditure and so on, which plays an important role

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in the steady development of the national economy, the improvement of the ecological environment, and the construction of social public utilities. Relative to the market self-regulation, the smooth development of socialist market economy can not be separated from the reasonable intervention of the government.

3.4. Unemployment Rate

Unemployment rate is an important index to measure the utilization of regional labor resources, the employment and living conditions of residents, and the level of regional economic development, which has a reverse corresponding relationship with the economic growth rate. The low unemployment rate indicates that the employment situation of the working population in the region is better, the income of the residents is more stable, and the living standard is constantly improving, thus stimulating domestic demand to promote consumption and forming a virtuous circle; conversely, the higher unemployment rate indicates that the regional economic development is depressed, which brings a series of negative effects.

3.5. Urbanization

Urbanization is a multi-dimensional concept, including population urbanization (rural population transformed into urban population), geospatial urbanization (rural areas transformed into urban areas), social civilization urbanization (production mode, ideological and cultural change) and economic urbanization (industrial structure urbanization). Rational urbanization has provided the motive force for creating employment opportunities, improving regional industrial structure, promoting industrial development, narrowing the gap of urban development and promoting social equity, which plays an important role in measuring the level of regional economic development.

Therefore, taking urbanization rate, industrial structure, unemployment rate, fixed assets investment and financial expenditure as the main indicators affecting the economic development of Shanxi Province, which can comprehensively reflect the economic development situation of Shanxi Province from the aspects of whether the industrial structure is reasonable, whether the government's behavioral ability needs to be strengthened, and the situation of regional employment and urbanization, it has strong persuasion.

4. EMPIRICAL ANALYSIS ON INFLUENCING FACTORS OF SHANXI ECONOMIC DEVELOPMENT

4.1. Indicator Access

Combined with the theoretical analysis of the above influencing factors and the availability of data, the following 8 indicators are selected, all of which are from Shanxi Statistical Yearbook.

The variables X1, X2 and X3 represent the proportion of the added value of the primary industry, the added value of the secondary industry and the added value of the tertiary industry in the GDP of Shanxi Province, mainly to explain the impact of the primary industry, the secondary industry and the tertiary industry on the economic development of Shanxi Province. X4 represents the proportion of fixed asset investment in GDP of Shanxi Province, which is mainly used to explain the impact of fixed asset investment on economic development. X5 represents the proportion of financial expenditure in GDP of Shanxi Province, which is used to explain the impact of government macro-control on the economic development of Shanxi Province. X6 is the registered urban unemployment rate of Shanxi Province, which is used to explain the effect of unemployment or employment on the living consumption and economic development of local residents. X7 is the urbanization rate of Shanxi Province, which is used to measure the contribution of economic urbanization.

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4.2. Correlation Analysis

Combined with the selected indicators, Shanxi Province per capita GDP is the explained variable y, Shanxi Province primary industry added value accounts for GDP proportion is X1, Shanxi Province secondary industry added value accounts for GDP proportion is X2, Shanxi Province tertiary industry added value accounts for X3,GDP proportion is Shanxi Province whole society fixed assets investment accounts for GDP proportion is Shanxi Province finance expenditure accounts for GDP proportion is Shanxi Province town register unemployment rate is X6. Shanxi Province urbanization rate is X7. The linear model of available y and X is:

$$y = \beta_0 + \beta_1 X1 + \beta_2 X2 + \beta_3 X3 + \beta_4 X4 + \beta_5 X5 + \beta_6 X6 + \beta_7 X7 + \varepsilon$$

Table 1 is a table of correlation numbers, including the Pearson correlation coefficient of 8 variables including independent and dependent variables and the probability of single-tailed significance.

The correlation between dependent variable y and independent variable X5, dependent variable y and independent variable X7 are all greater than 0.9 and the correlation between dependent variable y and independent variable X1, X3, X6 are all greater than 0.5. From the significance of the single-tailed test, the probability of variables is basically very small, from the significance of single tailed test, the dependent variable y is closely related to these five independent variables.

The following stepwise regression analysis method is used to further obtain the specific quantitative relationship between independent variables and dependent variables.

Table 1. Correlation coefficient tables

		y	X1	X2	X3	X4	X5	X6	X7
Pearson correlation	y	1.000	-0.759	-0.193	0.556	0.326	0.963	0.606	0.977
	X1	-0.759	1.000	-0.199	-0.289	-0.344	-0.825	-0.857	-0.845
	X2	-0.193	-0.199	1.000	-0.880	0.085	-0.179	0.278	-0.154
	X3	0.556	-0.289	-0.880	1.000	0.083	0.574	0.143	0.560
	X4	0.326	-0.344	0.085	0.083	1.000	0.442	0.551	0.388
	X5	0.963	-0.825	-0.179	0.574	0.442	1.000	0.718	0.986
	X6	0.606	-0.857	0.278	0.143	0.551	0.718	1.000	0.716
	X7	0.977	-0.845	-0.154	0.560	0.388	0.986	0.716	1.000
Significant (single tail)	y		0.000	0.183	0.002	0.060	0.000	0.001	0.000
	X1	0.000		0.175	0.085	0.050	0.000	0.000	0.000
	X2	0.183	0.175		0.000	0.346	0.202	0.094	0.236
	X3	0.002	0.085	0.000		0.350	0.002	0.252	0.002
	X4	0.060	0.050	0.346	0.350		0.015	0.003	0.031
	X5	0.000	0.000	0.202	0.002	0.015		0.000	0.000
	X6	0.001	0.000	0.094	0.252	0.003	0.000		0.000
	X7	0.000	0.000	0.236	0.002	0.031	0.000	0.000	

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4.3. Progressive Regression Analysis

SPSS 26.0 software is used for linear regression analysis of the data. Firstly, the economic development data of Shanxi Province is imported, and the step-by-step method is used to obtain the model. The results of regression analysis are as follows.

Table 2. Summary of models

Model	R	Adjusted R2	Errors in standard estimates	Debine-Watson
1	.977a	0.952	3160.689	
2	.986b	0.970	2528.615	1.652

Table 2 is the summary table of regression analysis results. After stepwise linear regression analysis, two models are fitted. Model 1 and model 2 correspond to the first row and the second row of Table 1 respectively. The R of model 1 is 0.997, the R2 is 0.954, the adjusted R2 is 0.952; the R of model 2 is 0.986, the R2 is 0.972, and the adjusted R2 is 0.970. The R values of model 1 and model 2 are better >0.9 fitting degree by observing the values, but the adjusted R2 values of model 2 are larger than the adjusted R2 values of model 1, which indicates that the fitting effect of model 2 is better.

Table 3. Residual statistics

	Minimum value	Maximum value	Average value	Standard deviation
Forecast	1963.338	47809.074	21326	14280.253
Residual	-4234.765	3927.899	0	2416.176
Standard residual	-1.675	1.553	0	0.956

Table 3 shows the residual statistics, the minimum standard residual is -1.675 and the maximum is 1.533. According to the principle of 3σ,the maximum of the standard residuals <3 ,and there is no singular data for the sample data.

According to the P-P diagram of the cumulative probability of observations, all the scattered points are closely around the two sides of the straight line, which basically shows that the residual error basically obeys the normal distribution.

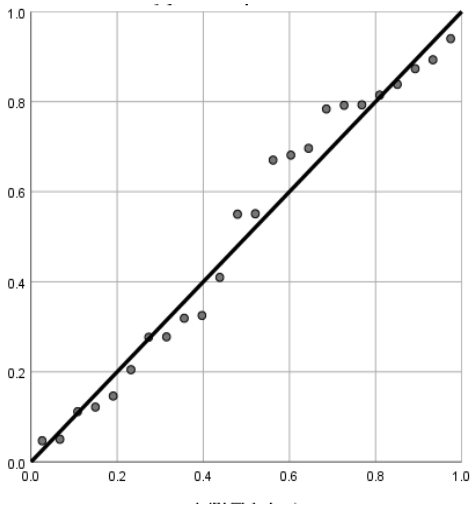

Figure 1. P-P Figure 1

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Table 4. Regression coefficient tables

Model		Unstandardized coefficient		Standardized coefficient	t	Significant significance	95.0% Confidence interval in B
		B	Standard error	Beta			
1	Constants	-45166.159	3163.533		-14.277	0	-51726.926
	Urbanization rates	1487.047	69.263	0.977	21.47	0	1343.405
2	Constants	-40896.932	2787.167		-14.673	0	-46693.163
	Urbanization rates	1694.738	79.347	1.113	21.359	0	1529.727
	Registered urban unemployment rate	-4524.306	1237.181	-0.191	-3.657	0.001	-7097.165

The two models for stepwise regression from Table 4 are:
Model 1: y=-45166.159+1487.047X7
Model 2: y=-40897.932+1694.738X6-4524.306X7

4.4. Analysis of Model Results

From the above analysis, the fitting degree of model 2 is higher than that of model 1. Therefore, model 2 is selected for further analysis. The results show that the urban unemployment rate and urbanization rate have a significant impact on the per capita GDP of Shanxi Province.

An unstandardized coefficient of urbanization rate is 1694.738, which indicates that the urbanization rate has a positive correlation with economic development. If the urbanization rate increases by 1 percentage point, the per capita GDP will increase by about 1694.738 yuan. An unstandardized coefficient of urban unemployment is -4524.306, which indicates that the urban unemployment rate has a negative correlation with economic development. If the urban unemployment rate increases by 1 percentage point, the per capita GDP will decrease by about - 4524.306 yuan.

5. CONCLUSIONS AND SUGGESTIONS

This paper draws the following two conclusions: first, although Shanxi Province has made remarkable achievements in the transformation and comprehensive reform in recent years, the problem of ecological environment protection needs to be solved urgently, and the industrial structure still needs to be adjusted. Second, increasing the urbanization rate and reducing the urban unemployment rate are conducive to promoting the optimization and upgrading of industrial structure and improving the level of economic development in Shanxi Province.

The following suggestions are put forward in combination with the actual situation of Shanxi Province. First, implement the strategy of rural revitalization and steadily promote the process of urbanization; Second, implement the tourism strategy to create more jobs; and third, promote the deep development of the coal industry, provide coal workers re-employment platform.

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