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Quantifying and Enhancing Regional Economic Vitality: A Multifaceted Approach to Urban Development and Policy Impact Analysis

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Abstract:

Quantifying economic vitality through economic data and evaluating indicators to inform economic policy poses a significant challenge. This paper proposes an appropriate strategy for enhancing a city's economic vitality by developing a relevant urban economic vitality model and analyzing pertinent data. Addressing the first issue, we examine the factors influencing regional economic vitality and devise a corresponding improvement plan. Concerning the second issue, we evaluate the impact of changes in economic policy on the regional economy within a specific area. For the third issue, we construct a model to assess and rank regional economic vitality. Lastly, for the fourth issue, we offer recommendations from three different perspectives.

Keywords:

Neural network; GM prediction; Analytic hierarchy process; Case analysis.

1. Introduction

1.1. Background

Economic vitality refers to the growth rate and potential of total supply and demand in a certainperiod of time. Urban economic vitality refers to the capacity and potential in the process of urban economic development. At present, China's cities are in a period of rapid growth. Their economic vitality is mainly reflected in their ability to introduce capital and to attract high- quality labor. In recent years, in order to improve economic vitality, some regions have introduced many preferential policies to stimulate economic vitality. How to quantify the so- called economic vitality is a major problem to be solved.

The analysis and decision-making of regional economic vitality and its influencing factors regional (or urban or provincial) economic vitality is an important part of regional comprehensive competitiveness.

In recent years, in order to improve economic vitality, some regions have introduced many preferential policies to stimulate economic vitality, such as reducing the approval steps of investment promotion, providing financial support for start-ups, and lowering the settlement threshold to attract enterprises. However, due to different resources, these policies have different roles in different regions. How to grasp the key factors and effectively improve the vitality of regional economy is a subject worthy of study. In order to study how to improve regional economic vitality, we have obtained some data. Please build a suitable model and use the data and the data from the survey to solve the following problems.

1. The economic vitality of a region (or city or province) is affected by many factors. Take a region (or city or province) as an example, please establish an appropriate relationship model of influencing factors of economic vitality, and study the action plan to improve regional

economic vitality. This paper analyzes the influence on the change of regional economic vitality from the perspective of the trend of population and enterprise vitality.

2. Select a region (or city or province) and analyze the short-term and long-term impact of economic policy transformation on the economic vitality of the region (or city or province) according to the appropriate data you survey.

3. Measuring regional economic vitality is a complex problem. Please select an appropriate indicator system, establish a mathematical model to analyze and measure regional (or city or provincial) economic vitality, and rank the city's economic vitality in Annex 3.

4. If you are the decision maker of regional economic development, please provide development suggestions for the region (or city or province) discussed in question 2 according to the conclusions of questions 1-3, so as to present the sustainable development with good economic vitality and stronger regional competitiveness of the region.

2. Hypothesis and symbol description

2.1. Hypothesis

1. Assume that the information given by the topic is true and accurate.

2. It is assumed that under the model, there will be no uncontrollable destructive events, such as wars, disasters, etc.

3. It is assumed that the global economic environment will not change significantly when the regional economy is studied.

4. It is assumed that only the economic differences between cities are considered, and other differences such as culture are not considered.

5. It is assumed that the attraction of specific talents due to climate, terrain and other reasons will not be considered.

2.2. Symbol description

P	*Regional economic vitality*
H	*population*
V	*Corporate vitality*
u	*Business survival rate*
s	*Average size of business*
n	*Number of companies*
y	*Normalized index*
S	*Optimal index set*
E	*Gray judgement matrix*

3. Model

3.1. Ovearll

We use the top-down modeling method to establish a model to provide relevant suggestions for managers and point out the way for regional economic development in the future. The main ideas are shown in the following figure:

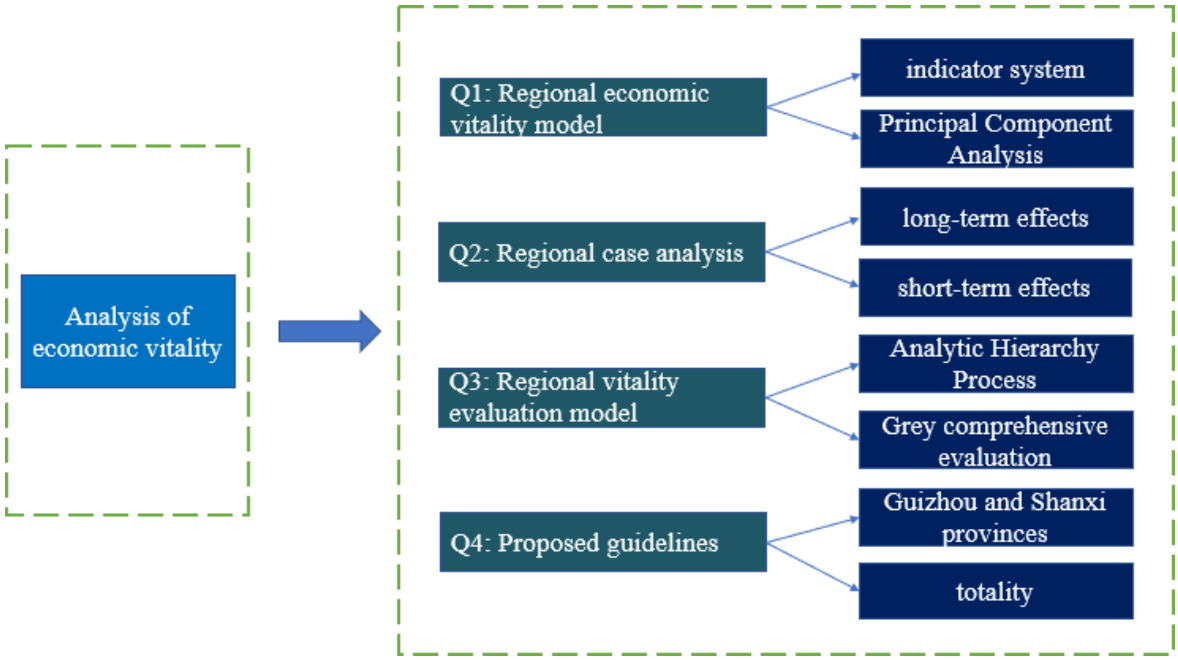

Figure 1. Structural diagram

According to the first problem, we first analyze the factors that affect the regional economic vitality and the impact of the relevant improvement programs. Then we get the final evaluationmodel based on the principal component analysis. Aiming at the second problem, we get the short-term and long-term impact of the policy on the regional economic vitality by analyzing the economic data of Shanxi and Guizhou. According to the third problem, we use Analytic hierarchy process and Grey Comprehensive Analysis to evaluate the economic vitality of each region. Finally, based on the results of the above analysis, we draw its recommendations for the overall and specific recommendations for Shanxi and Guizhou.

3.2. Population and enterprise model

3.2.1. Analysis of the first question

Many factors affect regional economic vitality, but in this section, we only need to consider the changes of population and enterprise vitality, and then establish a relevant model of regional economic vitality based on the analysis of the data.

3.2.2. Construction of index system

Before establishing the model, we need to carry out quantitative processing, so we first select some indicators with the following characteristics:

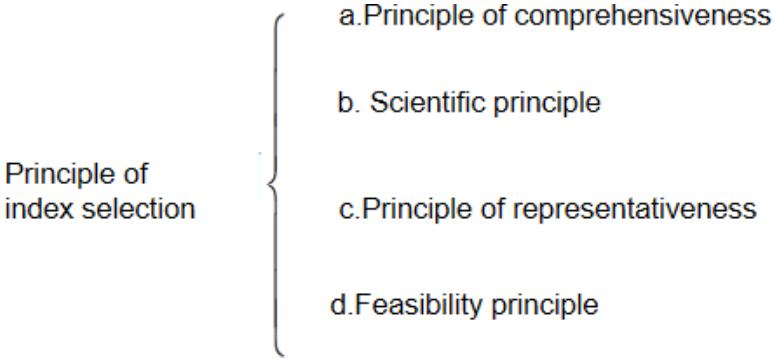

Figure 2. Principle of index selection

The above picture has the following meaning, comprehensive shows that this indicator can reflect the main content. The scientific nature shows that the way to deal with this indicator is logical. Representativeness shows that this indicator can represent most of the situation. The feasibility shows that this indicator can make it easier for us to obtain accurate data.

3.2.3. The influence of population and Enterprise vigor on the change of Regional Economic vigor

When considering the regional enterprise vitality ***V***, we can find that the development of the enterprise has a positive effect on the regional economic vitality ***P***. So we only need to choose influential indicators for analysis, which is number of enterprises ***n***, number of new enterprises ***N***, enterprise survival rate ***u***. Next, we will make a equal

In a relatively closed economy, more enterprises lead to more frequent trade, indicating greater economic vitality. In other words, the vitality of regional enterprises ***V*** is proportional to the number of regional enterprises ***n***. Then the emergence of new enterprises represents the emergence of new trade chains in the region, indicating that the region has better trade vitality. In other words, the vitality ***V*** of regional enterprises is proportional to the number of new enterprises ***N*** in the region. Moreover, the higher the survival rate of enterprises in the region, the broader the job market in the region, indicating that the vitality of enterprises in the region is higher. In other words, the regional enterprise vitality ***V*** is proportional to the regional enterprise survival rate ***u***.

As a result, we can get the prediction formula of regional economic vitality.

$$P = C \times n \times V \times u$$

We find that enterprise vitality V and population H are the influencing factors of regional economic vitality P, while the measuring factors of regional economic vitality P are composed of enterprise survival rate u, number of enterprises n and average enterprise size s.Their relationship is shown in the following figure

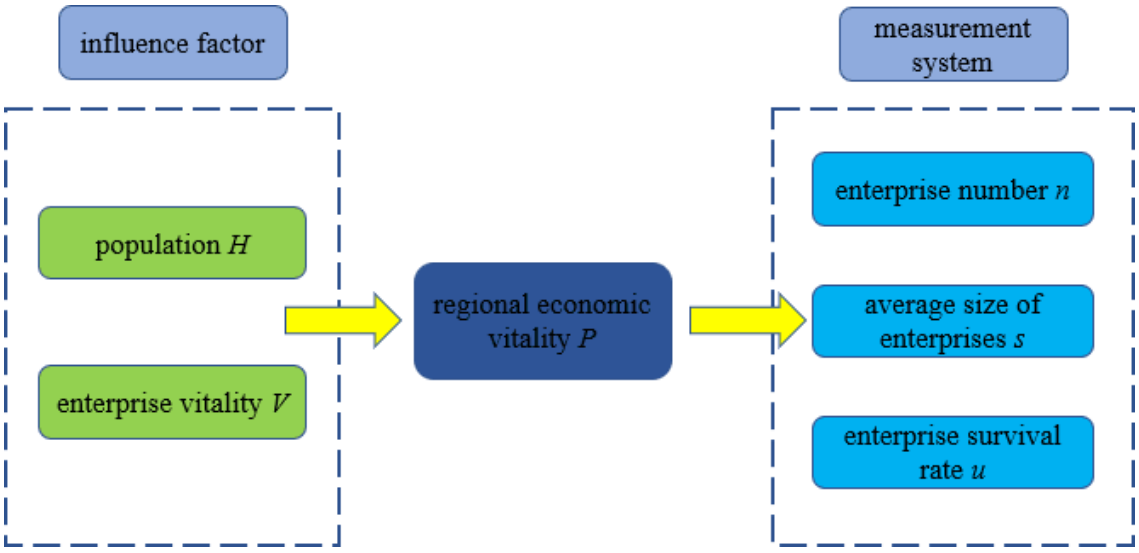

Figure 3. Regional economic vitality diagram

In this section, we use the data of Beijing, Shanghai, Guangzhou and Shenzhen for calculation.

Table 1.

	Beijing	Shanghai	Guangzhou	shenzhen
n	118.3	157.4	89.6	174.1
s	1.28	1.05	1.02	1.03
u	77.80%	76.80%	81.30%	85.70%
P	3.5	1.56	0.8	1.75
H	2172.9	2419.7	1404.35	1190.84
N	152.1	204.8	110.2	203.1
V	1.4	2.48	0.8	3.03

We use the data of the previous step and use the data of population and enterprise vitality to make a regression analysis of regional economic vitality to analyze the impact of population and enterprise vitality on regional economic vitality:

Table 2. Regression result data of population and enterprise vitality to regional economic vitality

Regression statistics			
Population vitality		Corporate vitality	
Mutiple R	0.45034941	Mutiple R	0.01242
R Square	0.202814591	R Square	0.0001542
Adjusted R Square	-0.19577	Adjusted R Square	-0.499768
Standard error	1.248	Standard error	1.3977
Observations	4	Observations	4

According to the results of our analysis, we find that the population plays a positive role in the development of enterprises, and the more the population will make the region have higher economic vitality.

3.3. The influence of the Transformation of Economic Policy on the Economic vigor of Shanxi Province

3.3.1. Analysis of the second question

In this section, we will analyze the economy and policies of specific regions. Because the policy is Markov, we use Markov chain for analysis. At the same time, we use Guizhou, whose data are similar with Shanxi, as a comparison to study the differences between the two provinces.

3.3.2. Research background and data sources

First of all, we analyze the economy of a particular region. In this section, we choose Shanxi Province as the object of analysis.

Shanxi Province is an important coal base in China, and has an important economic structure, which play an important role in China's economy.

3.3.3. Total Economic output and its changing trend in Shanxi Province

Over the past two decades, driven by China's policy, the economy of Shanxi Province has been growing continuously. However, there are also fluctuations in the economic growth of Shanxi Province

The economic situation of Shanxi Province showed a state of growth from 1998 to 2007, and reached its peak in 2007(15.9%). The economic situation of Shanxi Province showed a state of growth from 1998 to 2007, and reached its peak in 2007. After that, the economic growth rate of Shanxi Province showed a downward trend.In addition, we can also see the connection from the development trend of enterprises in Shanxi Province.

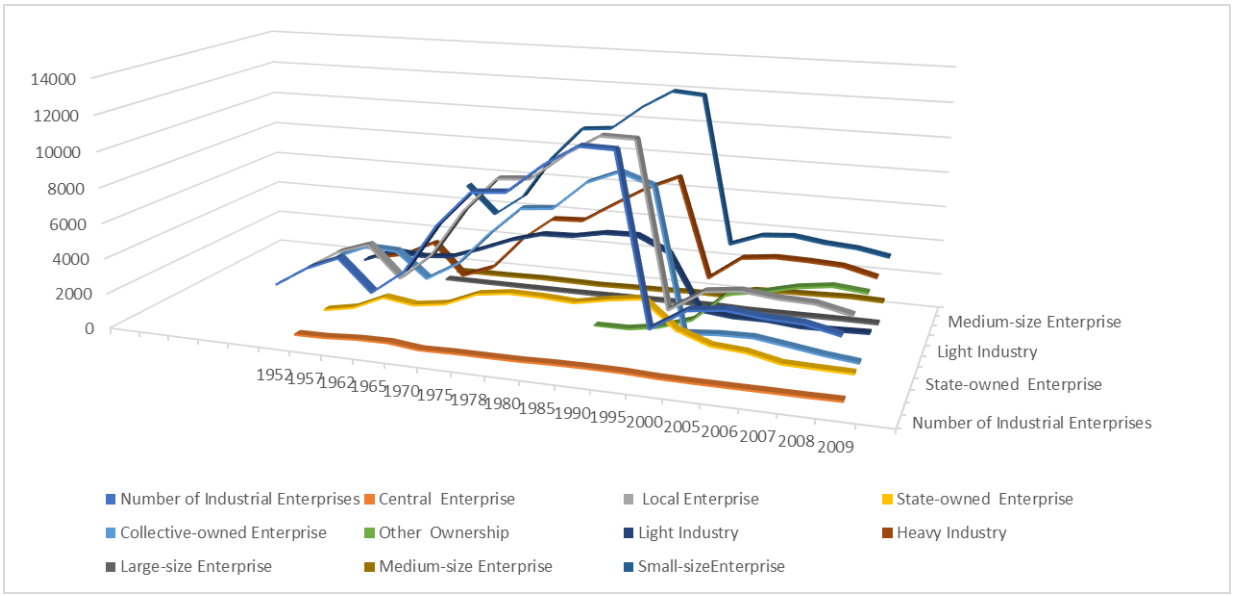

Figure 4. Changes of Enterprise vigor Indexes in Shanxi Province

3.3.4. Results

Based on the analysis of the above data, we find that the annual GDP can be directly used to represent the economic vitality of the region. After the economic reform in Shanxi in 2006, the economic vitality of Shanxi has increased greatly, surpassing Guizhou. However, in the long run, economic vitality will still decline after a period of time, and new policies are needed to stimulate it.

3.4. Construction of Economic Vitality Model

3.4.1. Historical Construction of Economic Vitality Model

In this section, we establish an economic vitality evaluation model of comprehensive indicators. The specific steps are as follows: screening the evaluation indicators, establishing the model, and deleting the redundant indicators.

3.4.2. Historical Construction of Economic Vitality Model

Many scholars in China have studied economic vitality. Yin Weihong found that economic vitality is mainly a measure of the speed of development, which is generally expressed by the mechanical growth rate and the annual growth rate of national income, gross social output and gross national product. Jin Yanjie believes that economic vitality is usually composed of factors such as residents' income, fiscal policy and social welfare. These experts generally use factor analysis for analysis.

However, these experts have constructed the same system when evaluating economic vitality, and there will be a lot of problems that can not be solved when using this system for analysis.

Therefore, we construct the comprehensive evaluation index system of regional economic vitality.

3.4.3. The selection of a large number of evaluation factors of regional economic vitality

The definition of economic vitality is the ability of a region's sustained economic growth, so we construct the evaluation system from eight aspects.

(1) Economic aggregate and growth

The total economic output reflects the scale of the economy and the efficiency of economic output, and is a very important factor in the evaluation system. But the total economic output is affected by the population, so we still need to consider the economic level per capita in order to get more accurate results. In addition, the rate of economic growth is also one of the factors of economic quality. So we choose the per capita GDP and GDP growth rate of GDP, as indicators.

(2) Enterprise and its benefit

Enterprise is the main carrier of economy and one of the important embodiment of economic vitality. We choose the sum of enterprise profits, profit growth rate, the growth rate of the number of Legal entity and the growth rate of Legal entity as indicators.

(3) The consumption of resident

Consumption is an important driving force of economic growth, so it is also one of the constituent factors of economic vitality.

So we choose per capita disposable income and per capita disposable income as indicators.

(4) Government’s regulation

In China, the government's macro-control has played an important role in economic growth. This is also one of the reasons for the rapid development of China's economy, so government’s regulation can be used as one of the factors of economic vitality. We choose fiscal expenditure, the ratio of government expenditure to GDP, government revenue, per capita revenue and the growth rate of per capita revenue as indicators.

(5) Social insurance

The better social insurance the region have, the greater confidence the resident will have for the future. Therefore, social security indirectly reflects economic vitality and can be used as one of the indicators.

(6) Foreign trade and foreign investment

The level of foreign trade and foreign investment shows the region's global competitiveness and is one of the reasons for the region's sustained economic growth.

Therefore, we choose the export volume in the current year, the actual amount of foreign capital utilized in the current year, and the per capita export volume in the current year as indicators.

(7) Technology research and development capability

Economic vitality comes from the birth of new technology, and new technology comes from the innovation of science and technology.

Therefore, we choose the proportion of scientific research funds and scientific research funds to GDP as indicators.

(8) Resident population

Regional economic development is inseparable from the local labor force, and the labor force is inseparable from the local population. Therefore, the resident population is also one of the indicators of economic vitality.

3.4.4. Determination of Evaluation Indexes of Regional Economic vigor

Based on the previous analysis of economic vitality factors, we use the following 22 indicators to evaluate, which are GDP, per capita GDP and per capita GDP growth rate, total profits of

industrial enterprises above scale, total profit growth rate of industrial enterprises above scale, number of legal entities, growth rate of annual per capita disposable income of residents, annual per capita disposable income of residents, government expenditure, proportion of government expenditure to GDP, government revenue, per capita revenue and per capita revenue growth rate, The social security rate of the current year, the export volume of the current year, the amount of foreign capital actually utilized in the current year, the per capita export volume of the current year, the per capita amount of foreign capital actually utilized in the current year, the proportion of scientific research funds to GDP, and the growth rate of resident population.

3.4.5. Eliminating redundant indicators

After processing by computer, we find that the correlation coefficient matrix between indicators is not a positive definite matrix, indicating that there are redundant indicators among the 22 indicators. So we need to eliminate some redundant indicators. The remaining indicators are: per capita GDP, growth rate of per capita GDP, growth rate of total profits of scale enterprises, annual per capita disposable income of residents, growth rate of annual per capita disposable income of residents, proportion of government expenditure in GDP, per capita fiscal revenue, growth rate of per capita revenue, social security rate of the current year, per capita actual use of foreign capital in that year, per capita exports of the current year, proportion of scientific research funds to GDP, growth rate of resident population, The numberof legal entities, the volume of exports in that year, and the amount of foreign capital actually utilized in that year. At this time, the matrix of the correlation coefficient has been greatly improved. However, there are still some indicators with low correlation and need to be furthereliminated.

Finally, we exclude the growth rate of per capita GDP, the growth rate of total profits of large- scale enterprises and the growth rate of resident population. We still have 12 indicators, whoseKMO reach 0.73.

3.4.6. Results

According to the results of the neural network model, we get the city rankings: Beijing, Shanghai, Shenzhen, Guangzhou, Chongqing, Suzhou, Tianjin, Chengdu, Nanjing, Wuhan, Qingdao, Hangzhou, Dongguan, Zhengzhou, Ningbo, Changsha, Xi'an, Shenyang, Kunming.

3.5. Advice

3.5.1. General suggestion

Based on the previous modeling results, we make the following recommendations:

(1) The number, size and survival rate of companies have a great impact on the economic vitality of the region. Therefore, if we want to maintain the economic vitality of the region, we need to attract more companies to develop in the region and introduce relevant policies to support new companies.

(2) Economic vitality is affected by many indicators, so reasonable economic transformation can inject new economic vitality into the region. After a period of time, the economic vitality of the region will be weak again, and a new policy is needed at such time.

(3) Population is one of the important factors affecting the economy, so it is necessary to set up a talent introduction mechanism and find local talents in order to maintain the vitality of the local economy.

3.5.2. The Enlightenment of the practice of Guizhou Province to Shanxi Province

Since 2011, the economy of Guizhou Province has made a great breakthrough, and the economic growth is in the forefront of the country, so it has accumulated a lot of experience of economic

transformation, which is of great reference for the industrial transformation and upgrading of Shanxi Province.

1. Innovative development ideas

The biggest problem in Shanxi Province is the single industrial structure, and the development ideas in recent years have been focused on energy and related industries.Therefore, Shanxi Province needs to establish new development ideas, not only to reasonably develop existing industries, but also to choose suitable emerging industries to develop.

2. Appropriate industrial transfer

In the context of the large-scale development of new energy, the original production capacity of the pillar industry in Shanxi Province has been greatly reduced. Therefore, we need to find new pillar industries to develop the economy, and learn from the experience of Guizhou Province to attract relevant industries from the eastern coastal areas to invest in Shanxi, so as to promote the economic development of the whole province.

3. Training and introducing professionals

For Shanxi Province, once the industrial specialty is carried out, it will face the situation of shortage of professionals.Therefore, Shanxi Province needs to promulgate new policies to attract new talents, such as introducing a subsidy scheme for relevant professionals, and enabling local universities to expand the number of enrollment of related majors.

4.Innovating the ways of attracting investment

At present, the economic growth of Shanxi Province needs a lot of foreign capital. Therefore, it is necessary to create a new investment model in order to attract more foreign businessmen to invest. Therefore, Shanxi Province should launch new ways of attracting investment, such as strengthening cooperation with investment institutions at home and abroad and publicizing investment information.

3.5.3. The Enlightenment of the practice of Shanxi Province to Guizhou Province

Shanxi is one of the most typical resource-based areas in China. it has carried out industrial structure adjustment in the whole province since 1990, and some experiences have been summed up in this process, which can be used for reference to the optimization of industrial structure in Guizhou Province.

1. Transforming traditional resource-based industries

In the development of emerging industries, we can not give up the original industries, but to use the way of industrial combination to promote the development of new and old industries at the same time.

Therefore, Guizhou Province can use the big data and Internet industry to improve the production efficiency of traditional industries.

2. Making full use of new energy

Guizhou Province relies on backward coal resources: in 2015, coal accounted for 38% of terminal energy consumption, 8% higher than the national average. Therefore, Guizhou Province needs to use wind energy and solar lamp new energy to replace coal, which can not only increase production efficiency but also protect the environment.

4. Summary

4.1. Strength

1. Innovative research methods: We use the methods of principal component analysis and grey comprehensive analysis to establish a model, introduce deep learning and neural network model, and analyze the effect of industrial structure on economic development at different stages of development on the basis of traditional static methods.

2. Innovative research content: We compare the development of the two resource-based regions, summarize the practices and experiences of the two provinces, and extract the enlightenment and suggestions suitable for the transformation and development of the two provinces and the resource-based areas of our country.

4.2. Weakness

1. Basically, we only refer to academic journals, and the carding of master's and doctoral dissertations and books still need to be improved.

2. The analysis of the industrial structure of Shanxi and Guizhou provinces only refers to the larger reform events, and there will be omissions for some small-scale innovations.

3. We only collected data after 1990 and did not discuss the industrial restructuring that took place from 1978 to 1990.

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