Construction of Early-warning Model of Unemployment Risk in GuiZhou Province

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Abstract. This research determines the unemployment risk indicators and constructs the unemployment risk early warning model of Guizhou Province through the hierarchical regression model, using software technology and combining the relevant indicator data of Guizhou Province. Then, according to the previous research, the unemployment warning line of Guizhou Province is determined. The registered unemployment rate of cities and towns in Guizhou Province and the unemployment rate predicted by the unemployment risk early warning model are compared with the unemployment warning line. Then, according to the comparison results, the unemployment situation in Guizhou Province is analyzed, and relevant policy suggestions and unemployment early warning are put forward.

1 Introduction

Guizhou Province is located in the western region of China. Most of the cities are located in deep mountains, and the transportation is underdeveloped. As a result, the economic development of these cities is relatively slow, the level of industrial structure is low, and jobs are scarce. Since the implementation of the Western Development Strategy, the economic development of Guizhou Province has been improved. The state has vigorously supported remote cities in Guizhou Province and opened up transportation arteries for these cities, which has changed the industrial structure of these cities and the employment situation of people. From 2010 to 2019, the urban unemployment rate in Guizhou Province will decline from the initial 3.64% to 3.11% in 2019. However, the number of unemployed people in Guizhou Province increased from 123400 in 2010 to 153300 in 2019. At the same time, in 2020, due to the outbreak of the epidemic, the unemployment rate of Guizhou Province once again rose to 3.75%, an increase of 0.11% compared with the unemployment rate in 2010, and the number of unemployed people also rose from 153300 in 2019 to 195000. It can be seen from these data that there are still some problems in the employment situation of Guizhou Province, and the number of unemployed people is still rising. If these situations are not well monitored and forewarned, they may cause the shrinkage of the consumer market in Guizhou Province, which will affect the stability of the society, bring huge hidden dangers to the society, and even bring significant risks to the economy and politics of Guizhou Province. However, there is no perfect early warning system for unemployment risk in Guizhou Province. Therefore, we need to build an unemployment risk early warning system to monitor and warn the unemployment situation in Guizhou Province.

2 Constructing the early-warning model of unemployment risk

With the implementation of national policies, the economy of Guizhou Province has achieved good development, the level of industrial structure is gradually improving, and the number of jobs created for the labor force is also gradually increasing. The registered unemployment rate in cities and towns shows a downward trend year by year. However, with the outbreak of the epidemic, China's employment situation has been greatly affected, and the unemployment rate across the country has risen. Among them, the registered urban unemployment rate in Guizhou Province has risen from 3.11% in 2019 to 3.75%, and the number of urban unemployed has increased by 41600. It can be seen that the employment problem is still a long-term challenge for Guizhou Province and even China. At present, China has determined the basic ideas and principles of prevention first, combination of prevention and treatment, and comprehensive treatment in terms of unemployment regulation, and established two mechanisms of "long-term" and "emergency". Liu Hongxia[1] believed that the "emergency" mechanism focused on "governance", which needs to be achieved through the establishment of an unemployment monitoring system, and the "long-term" mechanism focused on "prevention", which needs to be achieved through the establishment of an unemployment early warning system. The construction of the unemployment risk early warning model is an important part of the unemployment early warning system. With the help of this model, we can judge the warning signs of

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unemployment and analyze the warning situation, so as to achieve the purpose of regulating the unemployment risk. However, there is no relevant research on the construction of unemployment risk early warning model in Guizhou Province at present. Therefore, this study intends to build an unemployment risk early warning model suitable for Guizhou Province according to relevant literature.

Unemployment early warning is an important means to effectively prevent unemployment risks[2]. The establishment of unemployment risk early warning system can effectively help Guizhou Province to collect information reflecting economic operation and unemployment status. At the same time, the system can also monitor and warn the unemployment situation in Guizhou Province, analyze the unemployment trend, forecast and study unemployment and economic development, and put forward timely and effective solutions to the unemployment problems. This has provided great help in preventing and coping with unemployment risks and ensuring stable employment.

In foreign studies, scholars believe that the unemployment warning is usually simulated by establishing mathematical models to obtain relatively accurate unemployment warning lines[3], or based on the modeling of the macroeconomic early warning system[4]. For example, the moving average model adopted by Jeffrey[5], the autoregressive model adopted by Enrique[6]. The threshold autoregression model adopted by Hansen[7], the model based on the combination of fractional cointegration and smooth transformation autoregression adopted[8], and the time series autoregressive moving average model adopted[9]. On the basis of learning from foreign advanced methods and combining the actual situation in China, domestic scholars have studied the construction of early warning model of unemployment risk. For example, Zhao Jianguo, Zheng Yan and Zeng Xuemei used the diffusion index method to build the early warning model of unemployment risk; Zhang Xinghui et al. established the unemployment early warning model through hierarchical diagonal neural network and diagonal Elman neural network model respectively; Xiang Xiaodong et al. used support vector machine technology to establish an unemployment risk prediction model; Chen Zhongchang and Wu Yongqiu used BP neural network to build an early warning model of unemployment risk.

In general, China has made great progress in the research of unemployment risk early warning system. However, the current research has only been carried out in a few provinces, and there is still a lack of relevant practical and theoretical research on the unemployment risk early warning system in Guizhou Province. Therefore, this study intends to build an early warning model of unemployment risk by using the stepwise regression analysis method proposed by Mo Rong and Zhao Jianguo for reference.

2.1. Construction of unemployment risk early warning indicator system

The early warning index of unemployment risk is the basis of the early warning system of unemployment risk. Whether its selection is appropriate or not has a very important impact on the rationality and scientificity of the entire early warning system of unemployment risk. Although the unemployment risk early warning indicators are very important for the unemployment risk early warning system, how to ensure the rationality of indicators and the availability of indicator data will bring some difficulties to the selection of indicators. Therefore, in the actual operation process of indicator screening, it is also necessary to select appropriate indicators based on the actual situation, so as to ensure that all indicators are feasible, and can play a role in the unemployment risk early warning model, so as to better predict the unemployment situation in Guizhou Province. In this study, the indicators proposed by Mo Rong are proposed to be modified according to the actual situation of Guizhou Province, so as to determine the indicators of this study.

According to the contents of the unemployment early warning model, the unemployment risk early warning indicator system mainly includes two parts, namely, unemployment monitoring indicators and unemployment prediction indicators. Among them, unemployment monitoring indicators are mainly used to judge the specific situation of unemployment, and are generally applicable to short-term unemployment risk warning; The unemployment prediction index is mainly used to predict the future unemployment trend, and is generally applicable to the medium-term unemployment risk warning.

(1) Unemployment monitoring indicators

Unemployment monitoring indicators refer to indicators that can judge the overall situation of unemployment. In the labor market, most scholars focus on the change of unemployment rate[10] and the impact of unemployment on economic development. It can be seen that the unemployment rate is the core indicator to measure the unemployment situation. The specific calculation formula of unemployment rate is:

Unemployment rate=number of unemployed persons/(number of employed persons+number of unemployed persons) * 100%

Although the calculation formula of the unemployment rate has been determined, due to the different calculation and statistical methods of the unemployment rate in different places, there will be some differences when they explain the specific connotation of the unemployment rate. Therefore, when using the unemployment rate, we need to determine the specific connotation of the unemployment rate according to the actual situation.

At present, the statistical methods of unemployment rate in most countries are generally divided into two types, one is to register the unemployment rate, and the other is to investigate the unemployment rate. However, as the registered unemployment rate is easier to obtain data and implement than the survey unemployment rate,

the sampling survey was formally implemented after 1996. Therefore, China has long used the urban registered unemployment rate to measure unemployment, and the survey of unemployment rate has only been adopted in recent years. Therefore, this study intends to choose the urban registered unemployment rate of Guizhou Province to represent the unemployment rate of Guizhou Province.

In addition, unemployment is the result of matching labor supply and demand. Therefore, in addition to monitoring unemployment indicators, unemployment warning should also pay attention to indicators of labor supply and labor demand, including:

1. Labor supply indicators. Such indicators mainly determine the labor supply, including the proportion of working age population, labor participation rate, employment population ratio, etc.

(1) Proportion of working age population. The working age generally refers to the total population after the number of adults stipulated by law minus the number of legally retired people. The specific calculation formula is:

Proportion of working age population=(number of working age population/total population) * 100%

(2) The labor participation rate refers to the proportion of people of working age who actively participate in the labor market through work or job search. It is an indicator used to measure people's participation in economic activities. The specific calculation formula is:

Labor participation rate=(number of economically active population/number of working age population) * 100%

2. Labor demand indicators. These indicators mainly determine the factors of labor demand, involving economic, social and other aspects. Employment indicators can reflect the labor demand to a certain extent. Including: employment growth rate, employment elasticity and other indicators.

(1) The employment growth rate reflects the changing trend of employment, specifically the ratio of the number of employment growth in the current year to the number of employment last year. The specific calculation formula is:

Employment growth rate=(the number of employment increase in the year/the number of employment last year) * 100%

(2) Employment elasticity is a quantitative indicator to measure how employment growth changes with economic output growth. The specific calculation formula is:

Employment elasticity=employment growth rate/economic growth rate

Among them, due to the limitation of data search in Guizhou Province, this study uses GDP growth rate to express economic growth rate.

(2) Unemployment forecast indicators

Through the unemployment monitoring indicators of a region, we can judge the current or previous unemployment status of the region. The work of the unemployment early warning system is not limited to this. It needs to predict the trend of unemployment in advance, so as to prepare countermeasures in advance and provide a basis for future unemployment. From the existing research, we can find that the common unemployment prediction indicators include three indicators, namely macroeconomic indicators, labor indicators and policy indicators.

Macroeconomic indicators. Because the demand of labor market for labor is a kind of endogenous demand, the level of unemployment rate is closely related to the macroeconomic situation. All macroeconomic variables are often used as important indicators to predict unemployment.

Labor indicators. The unemployment rate is the result of changes in both supply and demand in the labor market. Macroeconomic factors determine the demand for labor, while the quantity and quality of labor determine the supply of labor. Therefore, when conducting unemployment warning, we should also take into account the factors of labor supply.

This research will combine the commonly used unemployment monitoring indicators and unemployment prediction indicators in the existing research, at the same time, according to the actual situation of Guizhou Province, in the next steps, screen out the unemployment risk early warning indicators suitable for this study.

2.2 Design of early warning indicators of unemployment risk

(1) Design principles of unemployment risk early warning indicator system

In order to ensure the scientificity and effectiveness of the unemployment risk early warning indicators, we should grasp the following principles in the process of screening and designing the indicator system, namely universality, significance, operability, effectiveness, etc. The principle of universality refers to that the selection and design requirements of indicators should be applicable to all regions and industries as far as possible. The principle of significance means that the indicators can well reflect the unemployment situation in a region, and can pass the statistical test, with the dynamic characteristics that can be predicted as the unemployment situation in the future. The operability principle means that indicators can be measured by data. The scientific principle means that the selected indicators must be defined in concept, have clear meanings, and can scientifically reflect the unemployment risk warning situation in the region.

(2) Screening of Early Warning Indicator System of Unemployment Risk

This study is prepared to screen early warning indicators of unemployment risk according to the correlation analysis proposed by Mo Rong and Bao Chunlei. First of all, this study refers to the unemployment early warning indicators mentioned in Mo Rong's book "Construction and Application of Unemployment Early Warning Model", and searches for relevant data in the Guizhou Statistical Yearbook issued by the Guizhou Provincial Bureau of Statistics and the China Statistical Yearbook issued by the National

Bureau of Statistics. In this step of operation, due to the limitation of data collection, this study only collected the urban registered unemployment rate, working age population, economically active population, total population, employment, new employment, gross domestic product (GDP), GDP growth rate, added value of the primary industry, added value of the secondary industry, added value of the tertiary industry, total investment in fixed assets, consumer price indicators According to the data of the 14 indicators of the retail price index of goods, and according to the relevant formula, we calculated the proportion of working age population, labor participation rate, employment growth rate, economic growth rate, employment elasticity and other indicators, in which the economic growth rate can be replaced by GDP growth rate. Finally, five unemployment monitoring indicators are obtained, which are respectively the urban registered unemployment rate, the proportion of the working age population, the labor participation rate, the employment growth rate, and the employment elasticity. Nine unemployment prediction indicators are respectively GDP, the added value of the primary industry, the added value of the secondary industry, the added value of the tertiary industry, the number of working age population, the total investment in fixed assets, the consumer price index of residents, the retail price index of goods, and the average wage of on-the-job workers. In this study, the working age is considered as 15-64 years old when collecting the working age population, which is consistent with international standards.

2.3 Construction of early warning model of unemployment risk

(1) Indicator selection and data source

In order to more accurately predict the future unemployment situation in Guizhou Province, we need to build a mathematical model to visualize the selected indicators, so that we can more intuitively see the changing trend of the unemployment rate in Guizhou Province. Because the unemployment early warning model we built is to explore the changes of the unemployment rate in Guizhou Province in the future. Therefore, this study preliminarily selected the above nine unemployment prediction indicators and the urban registered unemployment rate in the unemployment monitoring indicators as the warning source of the unemployment warning model, and the urban registered unemployment rate is the core indicator in this study, which is used to represent the unemployment rate of Guizhou Province. The data of these 10 indicators are from Guizhou Statistical Yearbook issued by Guizhou Provincial Bureau of Statistics and China Statistical Yearbook issued by the National Bureau of Statistics. Among them, the number of working age population is from the China Statistical Yearbook, and the other indicators are from the Guizhou Statistical Yearbook.

The above nine unemployment prediction indicators are all indicators of great significance to the economic development of Guizhou Province, so they will all play a certain role in predicting the unemployment rate of Guizhou Province to a certain extent. However, these indicators are only selected through qualitative methods. Whether they can really play a role in predicting the unemployment rate of Guizhou Province, we need to further verify them through mathematical methods. On the basis of the primary indicators, this study intends to use quantitative methods to analyze the correlation between the unemployment prediction indicators and the urban registered unemployment rate, and screen out the indicators that are significantly related to the urban registered unemployment rate. The specific results are shown in Table 1 below:

Table 1: The results of the correlation analysis between the unemployment forecast indicators and the urban registered unemployment rate

	GDP	Added value of primary industry	Added value of secondary industry	Added value of the tertiary industry	Population of working age	Total investment in fixed assets	CPI	Commodity retail price index	Average wages of on duty employees
Registered urban unemployment rate (%)	-0.671**	-0.650**	-0.709**	-0.650**	0.463	-0.680**	0.393	0.333	-0.704**

**. When the confidence level (double test) is 0.01, the correlation is significant.

It can be seen from this that among the unemployment prediction indicators, the number of working age population, consumer price index and retail price index are not significantly correlated with the urban registered unemployment rate. This result shows that other indicators other than these three indicators may have a predictive effect on the urban registered unemployment rate. Therefore, the unemployment forecast indicators finally selected in this paper are gross domestic product (GDP), added value of the primary industry, added value of the secondary industry, added value of the tertiary industry, total investment in fixed assets, and average wages of on-the-job workers.

(2) Data selection and preprocessing

When collecting data, this study selects the annual data from 2006 to 2020 for research. The unemployment rate is expressed by the urban registered unemployment rate. The urban registered unemployment rate and the unemployment forecast index data are both from Guizhou Statistical Yearbook and China Statistical Yearbook.

As this study intends to use the method of linear model to forecast the unemployment rate, in order to ensure the linear relationship between the dependent variable and the independent variable, this study chooses to process the data of all indicators with logarithm, and the specific data obtained are shown in Table 2.

Table 2: Data of each indicator

particular year	the registered urban unemployment rate	Ln (registered urban unemployment rate)	Ln (GDP)	Ln (added value of primary industry)	Ln (added value of the secondary industry)	Ln (added value of the tertiary industry)	Ln (total investment in fixed assets)	Ln (average wages of on-the-job employees)
2006	4.11	1.41	7.72	5.91	6.86	6.85	7.09	9.73
2007	3.97	1.38	7.95	6.07	7.08	7.11	7.31	9.94
2008	3.98	1.38	8.16	6.26	7.27	7.34	7.53	10.11
2009	3.81	1.34	8.26	6.28	7.36	7.47	7.80	10.25
2010	3.63	1.29	8.42	6.40	7.51	7.65	8.07	10.36
2011	3.63	1.29	8.63	6.55	7.72	7.89	8.35	10.53
2012	3.29	1.19	8.82	6.76	7.91	8.06	8.65	10.66
2013	3.26	1.18	8.98	6.91	8.06	8.24	8.91	10.80
2014	3.27	1.18	9.12	7.16	8.18	8.37	9.11	10.91
2015	3.29	1.19	9.26	7.40	8.30	8.49	9.30	11.04
2016	3.24	1.18	9.38	7.53	8.40	8.61	9.49	11.15
2017	3.23	1.17	9.52	7.62	8.51	8.80	9.67	11.23
2018	3.16	1.15	9.64	7.68	8.61	8.95	9.82	11.32
2019	3.11	1.13	9.73	7.73	8.71	9.04	9.83	11.38
2020	3.75	1.32	9.79	7.84	8.73	9.11	9.86	11.45

Note: Index data are from Guizhou Statistical Yearbook and China Statistical Yearbook

(3) Model construction

This research is based on the stepwise regression method to build the unemployment early warning model. Stepwise regression means that in the process of establishing the multiple regression equation, independent variables are introduced into the equation one by one, and then the partial correlation coefficients of each independent variable introduced into the equation are statistically tested. The independent variables with significant effects remain in the equation, and the variables without significant effects are excluded. After repeated this process for many times, until no more variables are introduced and eliminated, the regression model with the best fitting effect is obtained.

Since the purpose of this study is to predict the future changes in the unemployment rate of Guizhou Province, we need to predict the future unemployment rate of Guizhou Province through some current data of Guizhou Province. In view of the lagging statistical data of Guizhou Province, we should forecast the unemployment rate at least one year in advance. Therefore, this study takes the logarithm of the urban registered unemployment rate as the dependent variable Y, and the logarithm of the gross domestic product (GDP), the added value of the primary industry, the added value of the secondary industry, the added value of the tertiary industry, the total investment in fixed assets, and the average wage of on-the-job workers one year in advance as the independent variable X, and constructs an unemployment risk early warning model through the stepwise regression equation in SPSS software. The results are shown in Table 3, Table 4, Table 5:

Table 3: Situation of stepwise regression model

Model	R	R^2	AdjustR^2	Errors in standard estimates
1	0.808[a]	0.654	0.627	0.0582
2	0.875[b]	0.765	0.726	0.0499

Note: a Forecast variables: (constant), ln(total investment in fixed assets)

b. Forecast variables: (constant), ln(total investment in fixed assets), ln(added value of the primary industry)

Table 4: Change of F value in stepwise regression model

Model		Sum of squares	freedom	mean square	F	Significance
one	regression	.083	1	.083	24.523	.000[b]
	residual	.044	13	.003		
	total	.127	14			
two	regression	.097	2	.049	19.507	.000[c]
	residual	.030	12	.002		
	total	.127	14			

Note: a Dependent variable: ln (urban registered unemployment rate)

B. Forecast variables: (constant), ln (total investment in fixed assets)

C. Forecast variables: (constant), ln (total investment in fixed assets), ln (added value of the primary industry)

Table 5: Stepwise regression model of unemployment warning

Model		Denormalization coefficient		Standard coefficient	t	Significance	Collinearity statistics	
		B	Standard error				allow	VIF
one	Constant	1.896	0.131		14.506	0.000		
	Ln (total investment in fixed assets)	-0.075	0.015	-0.808	-4.952	0.000	1.000	1.000
two	Constant	1.483	.206		7.181	0.000		
	Ln (total investment in fixed assets)	-0.287	0.090	-3.072	-3.198	0.008	0.021	47.066
	Ln (added value of primary industry)	0.325	0.136	2.288	2.382	0.035	0.021	47.066

Note: a Dependent variable: ln (urban registered unemployment rate)

It can be seen from the above results that the urban registered unemployment rate of Guizhou Province can be predicted by the two indicators of the previous year's total fixed asset investment and the added value of the primary industry. The specific model can be expressed as follows:

Ln (registered urban unemployment rate)$_t$=1.483-0.287 * ln(total investment in fixed assets)$_{(t-1)}$+0.325 * ln (added value of the primary industry)$_{(t-1)}$, where t represents year t

(4) Calculation result analysis

After constructing the model, this study prepares to test the model. The test is done mainly by predicting the urban registered unemployment rate from the available data. We can find that the absolute value of the error between the urban registered unemployment rate calculated by the unemployment risk warning model constructed in this study and the actual urban registered unemployment rate is within 1.5%. According to the research results of Chunlei Bao, the prediction effect is better when the absolute value of the error between the predicted and the actual urban registered unemployment rate is within 3%[2]. Thus, it can be shown that the model we constructed can better predict the urban registered unemployment rate in Guizhou Province.

3 Delineation of unemployment warning line in Guizhou Province

After constructing the unemployment risk early warning model of Guizhou Province, we also need to build an unemployment warning line of Guizhou Province, so that we can judge the specific situation of the unemployment rate of Guizhou Province after we predict the unemployment rate of Guizhou Province in the future through the model. To build the unemployment warning line in Guizhou Province, we need to start from the economic development level of Guizhou Province, urban unemployment situation and other aspects, and combine the actual situation of Guizhou Province to determine the tolerance of Guizhou Province to unemployment, which is an acceptable unemployment rate for workers, enterprises and society.

From a normative point of view, the unemployment warning line of Guizhou Province should be determined through a mathematical model. On the basis of fully considering various factors affecting urban unemployment, a relatively accurate unemployment warning line can be calculated. However, at present, the unemployment monitoring system in Guizhou Province is not perfect, and the impact of many factors on unemployment has not been explored clearly. In addition, the data we can collect are not complete and may not be accurate, which makes the data collected may not be able to comprehensively reflect urban unemployment. Therefore, this study decided to refer to the "Five Lights System" mentioned by Zhao Qiang in his article "Exploration of Establishing the Urban Unemployment Monitoring and Early Warning System in Western China" to determine the unemployment warning line in Guizhou Province. The specific unemployment warning line is shown in Table 6 below.

Table 6: Unemployment Warning Line of Guizhou Province

Unemployment warning range	Unemployment warning light	Unemployment alert	Urban unemployment
Less than 4%	Light green light	No alarm	Unemployment is in a state of no alarm. The labor resources are fully utilized and the society is stable.
4%~6%	green light	Light alarm	Unemployment is in a state of light alarm, and labor resources can be effectively used. Unemployment has little impact on the social economy, and it is conducive to the labor force participating in training and playing the competitive role of the labor market.
6%~8%	Yellow light	Central police	Unemployment is in the state of middle alarm. The unemployment problem is more prominent, the supply of labor resources is loose, and the degree of social instability has increased, which has had a negative impact on the social economy. Attention should be paid
8%~10%	red light	Senior police	Unemployment is on high alert. The unemployment problem is serious, some labor resources are idle, and the degree of social instability is increasing. Send an alarm, closely monitor the changes of unemployment, implement the unemployment emergency plan, and timely solve the unemployment problem
More than 10%	Purple red lamp	Serious alarm	Unemployment is in a state of serious alarm. The unemployment problem is particularly serious. A large number of labor resources are idle, and social unrest may occur at any time, causing great harm. Immediately issue a serious alarm, take emergency measures, implement the unemployment emergency plan, and effectively solve the unemployment problem .

Note: The content comes from Zhao Qiang's Exploration of Establishing a Monitoring and Early Warning System for Urban Unemployment in Western China

4 Analysis of the Unemployment Police in Guizhou Province

Due to the lag of the data, this study predicted the urban registered unemployment rate in 2022 based on the unemployment risk warning model, with the result of 3.43%. Referring to the unemployment warning line we have determined, Guizhou Province is still in a state of no alarm, with full utilization of labor resources and social stability. However, according to the latest data, the registered urban unemployment rate in Guizhou Province will be 4.45% in 2021. According to the "Five Lights System", the unemployment rate in Guizhou Province will reach the warning line of mild unemployment in 2021, which indicates that although the unemployment situation in Guizhou Province has reached the warning line, the impact of unemployment on the social economy is still small, and the labor resources in Guizhou Province can still be effectively used. According to the urban registered unemployment rate in 2022 predicted by the unemployment risk early-warning model constructed in this study, it can be seen that the unemployment rate in Guizhou Province will be reduced to a state of no alarm in 2022. Therefore, in the current situation, the unemployment situation in Guizhou Province is good.

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