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Research on the Prediction of the Proportion of Urban Employment Population under the Background of New Urbanization

-- Based on the Gray Prediction Model

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Abstract

Full employment is one of the three major objectives of fiscal expenditure. Accurately predicting its development trend has reference significance for the allocation of fiscal budget. Based on the 2001-2020 China Population and Employment Statistical Yearbook, based on GM(1,1), DGM(1,1), and grey Verhulst model, this paper constructs a combined prediction model through the least squares method. After fitting, testing and forecasting, it is concluded that the proportion of urban employment in China will exceed 60% in 2022, and the growth trend will gradually slow down. Finally, through the analysis of the predicted value, relevant suggestions on new urbanization are put forward.

Keywords

Urban Employment Proportion; GM(1,1); DGM(1,1); Grey Verhulst Model.

1. Introduction and Literature Review

In 2019, the proportion of urban employment in my country has exceeded 57%, which means that my country has taken another solid step on the road of urbanization and entered a stage of medium and high-speed development. The acceleration of the urbanization process is bound to be accompanied by the transfer of more rural labor force, and employment is the basic guarantee for the rural labor force to have a foothold in the city. In recent years, China's economy has shifted from high-speed growth to high-quality development, and the large number of jobs created previously have gradually become saturated. The employment structural contradictions faced by cities and rural areas have become increasingly prominent. The pressure of high employment in cities and the transfer of low-skilled labor in rural areas are two factors. These phenomena are intertwined and hinder the process of urbanization. Therefore, with the increase of urban employment population, it is of great practical significance to predict the proportion and development trend of urban employment population. Starting from the status quo, this paper analyzes and forecasts the proportion of the urban labor force, in order to provide a relevant basis for the government's future macroeconomic strategy.

In the research of foreign scholars, Northam (1979) analyzed the urbanization development process of many countries in the world, and proposed the "periodic law of urbanization", and urbanization will be a stretched S-shaped curve. According to the two quantiles of 30% and 70%, urbanization is divided into three stages: initial stage, middle stage and high stage. Todaro (1969) took developing countries as a sample to analyze the coexistence of rural labor inflow and urban unemployment, and obtained the negative impact of labor migration, and believed that the flow of rural population should be slowed down. Alleviate the problem of employment in expanding cities.

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Based on the research of foreign scholars, domestic scholars have carefully analyzed China's urban employment problem from the perspective of dual economic structure. Zhou Tianyong (2001) pointed out that Todaro's restriction of rural population flow not only does not promote urban employment but also shows a restraining effect, and believes that accelerating the transfer of rural surplus labor and rationally guiding the flow are the effective ways to solve the urban-rural structural contradiction. Zhu Nong (2008) pointed out that the low operating efficiency of township enterprises is a major factor in the outflow of rural labor, and population urbanization is the main way to alleviate the rural surplus labor. Yang Yiyong (2005) conducts a dynamic analysis of urbanization and employment development, and believes that population urbanization is of great significance to solving the employment problem in China, and clarifies the main obstacles to the urbanization process and underemployment. Xiang Jing and Zhou Lingling (2021) used the Leslie population prediction model to estimate the future urbanization process, pointing out that the estimated urbanization rate in 2035 will reach 77.21%, and the urbanization strategy needs to be adjusted appropriately according to population development.

To sum up, scholars at home and abroad have conducted detailed research on the process of urbanization and employment from multiple samples and multiple perspectives, but there are the following shortcomings: (1) There is no clear definition for the measurement of urbanization; (2) There is no forecasting analysis from the perspective of urban employment population. Therefore, this paper turns the research perspective from urbanization without a unified measurement standard to the urban employment population, and obtains a basic understanding and understanding of the urban population employment and urban-rural relationship through the prediction of this indicator.

2. Data Sources and Current Situation Analysis

The data selected in this paper is the "China Population and Employment Statistical Yearbook" from 2001 to 2020, and the selected indicator is the proportion of urban employed population. The calculation formula is the proportion of urban employed population = urban employed population/total employed population. Among them, employed persons refer to persons over 16 years old who have engaged in labor for more than 1 hour (including 1 hour) during the survey week in order to obtain remuneration or operating profit; or temporarily do not work during the survey week due to on-the-job study, vacation, etc personnel; or those who are temporarily not working due to work stoppages, unit downturns, etc. Urban population refers to the total resident population living within the city limits.

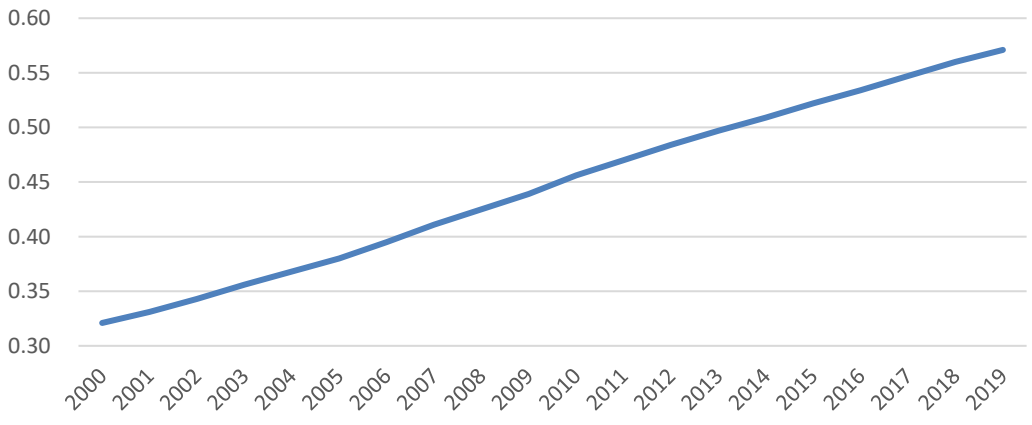

Figure 1. Proportion of urban employment population from 2000 to 2019

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Figure 1 shows the trend change of the urban employment population from 2000 to 2019. It can be seen from the figure that the urban employment population increased from 32% in 2000 to 57% in 2019, an increase of 25%. The increase is quite obvious and has been keep it steady. Based on this trend, it can be intuitively concluded that the proportion of urban employment population will maintain a steady growth in the future.

3. Model Construction and Prediction

3.1. GM(1,1) Model

Grey prediction is a prediction method that establishes a mathematical model to make predictions through a small amount of incomplete information. Based on the past and present development laws of objective things, this method describes and analyzes future development trends and conditions, and forms scientific assumptions and judgments. The GM(1,1) model is a basic grey forecasting model and one of the powerful tools in grey forecasting. The gray prediction steps of the GM(1,1) model are as follows:

Let the incomplete information non-negative sequence be, and generate the 1-AGO (1-Accumulating Generation Operational) sequence . The 1-AGO sequence resembles a cumulative polyline in a Pareto chart. That is, let the original sequence be , and generate a new sequence as , where . Use calculus knowledge to construct the grey differential equation of GM(1,1) model, where is the development coefficient and is the grey action. The GM(1,1) model Z(1) in the mean form is obtained by the formula. The GM(1,1) model Z(1) in the mean form is obtained by the formula, , , and the gray prediction matrix is constructed:, let . Build the function by least squares and find the estimates:, . The whitening differential equation of GM(1,1) is: , obtain the response function through , and calculate , to obtain the gray prediction model .

3.2. DGM(1,1) Model

The DGM(1,1) model and the GM(1,1) model can be considered as different expressions of the same model, and can be substituted for each other when they are small. The DGM(1,1) model is the discrete form of the GM(1,1) model , the modeling process is as follows:

In the first step, let be a non-negative sequence, . $X^{(0)}=\left\{X^{(0)}(1),X^{(0)}(2),...,X^{(0)}(n)\right\}$ The second step is to calculate an accumulation of generated sequence , $X^{(1)}=\left\{X^{(1)}(1),X^{(1)}(2),...,X^{(1)}(n)\right\}$ where . The third step is to use the least squares method to calculate the parameter values. If is the parameter list and , $Y=\begin{bmatrix}x^{(1)}(2)\\x^{(1)}(3)\\\vdots\\x^{(1)}(n)\end{bmatrix},B=\begin{bmatrix}x^{(1)}(1) & 1\\x^{(1)}(2) & 1\\\vdots & \vdots\\x^{(1)}(n-1) & 1\end{bmatrix}$ then the least squares estimated parameter list of the discrete gray prediction model satisfies . The fourth step, take , $X^{(1)}(1)=X^{(0)}(1)$ then the recursive function is or . The fifth step is to find the reduction value . $\hat{X}^{(0)}(k+1)=\hat{X}^{(1)}(k+1)-\hat{X}^{(1)}(k)$

Using GM(1,1) to predict sometimes can not obtain stable and ideal results. The gray prediction model is based on the exponential fitting curve of the least squares method, but when the pure exponential is used for fitting, it cannot achieve a completely satisfactory effect. , there are often some deviations. Therefore, DGM(1,1) expands the modeling mechanism of the GM(1,1) form, and can completely fit pure exponential sequences and non-homogeneous exponential sequences, effectively avoiding the whitening equation of the GM(1,1) model to the whitening response. error between the formulas.

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3.3. Gray Verhulst Model

The basic idea of the gray Verhulst model is that the number of biological individuals grows exponentially, and is limited by the surrounding environment, the growth rate gradually slows down, and finally stabilizes at a fixed value. This model is mainly used to describe the process with saturated state, namely "S" type process, which is often used in population prediction, biological growth, reproduction prediction and product economic life prediction. The modeling process of this model is as follows:

The first step is to establish the original data sequence with time series, $X^{(0)}=\{x^{(0)}(1),x^{(0)}(2)...x^{(0)}(n)\}$ and accumulate the data and generate the sequence next to the mean value. Let , $X^{(1)}(k)=\sum_{t=1}^{k}x^{(0)}(t)$ then the cumulative generated sequence is . The second step is to generate a sequence of adjacent mean values , where . $X^{(1)}=\left\{x^{(0)}(1),\sum_{t=1}^{2}x^{(0)}(t)...\sum_{t=1}^{n}x^{(0)}(t)\right\}$ The third step is to establish the Verhulst model function: , is the parameter to be determined, the differential equation of the function is , and the solution is . Finally, the Verhulst prediction model is obtained: , $X^{(1)}=\left\{x^{(0)}(1),\sum_{t=1}^{2}x^{(0)}(t)...\sum_{t=1}^{n}x^{(0)}(t)\right\}$ and the undetermined parameters are estimated by least squares: . $x^{(0)}(k+1)=x^{(1)}(k+1)-x^{(1)}(k)$

3.4. Combined Forecasting Model

The above three gray prediction models are combined by the least square method: the values predicted by each model are used as dependent variables, and the actual values are used as independent variables to construct a multiple linear regression equation:

$$Y_{real}=aX_{GM}+\beta X_{DGM}+\gamma X_{Verhulst}+\varepsilon$$

where is the actual value, is the predicted value of the GM(1,1) model, is the predicted value of the DGM(1,1) model, is the predicted value of the gray Verhulst model, and is the undetermined coefficient.

Taking the urban employment population ratio from 2000 to 2015 as the fitting data of the combined forecasting model, and using the urban employment population ratio from 2015 to 2019 as the test data of the combined forecasting model, forecasting the urban employment at the end of the year from 2020 to 2025 The proportion of the population. The predicted value of the urban employment-population ratio at the end of each year obtained by the GM(1,1) model, the DGM(1,1) model and the gray Verhulst model is used as the explanatory variable, that is, the 4th, 5th, and 6th columns of Table 1 are used as the explanatory variables. The actual value of the urban employment population ratio obtained in the "China Population and Employment Statistical Yearbook" is used as the explained variable, that is, the first column of Table 1 is used as the explained variable. The least squares estimation is performed by stata16.0 software, and the multiple linear regression is obtained. The equation is:

$$Y_{real}=172.489X_{GM}-172.2526X_{DGM}+0.833268X_{Verhulst}-2.235285$$

Based on the gray combination forecast model of the least squares method, the predicted value of the urban employment population ratio from 2015 to 2019 is shown, which is closer to the actual value.As shown in Table 2, after substituting the predicted values of the urban employment population ratio from 2020 to 2025 by the GM(1,1) model, the DGM(1,1) model and the gray Verhulst model into the regression equation, we can get the results based on the least squares method. The predicted value of the urban employment population ratio of the

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combined grey forecast model is that the predicted value of the urban employment population ratio in 2020 is 58.33%, the predicted value of the urban employment population ratio will exceed 60% by 2022, and will reach 63.51% by 2025. It can be seen from the results that the growth of the urban employment population will show a slowing trend. This may also be due to the fact that the state has attached great importance to the "three rural" issues and vigorously promoted rural revitalization in recent years, and rural areas have released more Employment opportunities have improved the crowded employment phenomenon in cities and eased structural contradictions.

Table 1. Actual and predicted values of urban employment-population ratio in each year of GM(1,1), DGM(1,1) and grey Verhulst models

years	Real(%)	GM(1,1)	DGM(1,1)	Verhulst
2000	32.1	32.10	32.10	32.10
2001	33.1	34.09	34.10	33.38
2002	34.3	35.13	35.14	34.67
2003	35.6	36.20	36.21	35.98
2004	36.8	37.31	37.31	37.31
2005	38	38.44	38.45	38.65
2006	39.5	39.61	39.62	40.00
2007	41.1	40.82	40.82	41.35
2008	42.5	42.06	42.07	42.71
2009	43.9	43.34	43.35	44.07
2010	45.6	44.66	44.67	45.42
2011	47	46.03	46.03	46.78
2012	48.4	47.43	47.43	48.13
2013	49.7	48.87	48.88	49.47
2014	50.9	50.36	50.37	50.79

Data source: China Population and Employment Statistical Yearbook.

Table 2. Predicted value of urban employment population proportion of grey combination prediction model

years	Real (%)	GM(1,1)	DGM(1,1)	Verhulst	Predictive value
2015	52.2	51.89	51.9	52.11	52.20
2016	53.4	53.47	53.48	53.4	53.49
2017	54.7	55.1	55.11	56.48	54.75
2018	56	56.78	56.79	55.94	55.98
2019	57.1	58.51	58.52	57.17	57.18
2020		60.29	60.3	58.38	58.33
2021		62.13	62.14	59.57	59.45
2022		64.02	64.03	60.73	60.53
2023		65.97	65.98	61.86	61.57
2024		67.98	67.99	62.96	62.56
2025		70.05	70.06	64.02	63.51

Data source: China Population and Employment Statistical Yearbook.

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4. Conclusions and Recommendations

4.1. Conclusion

China's urban employment population will continue to grow for some time in the future, breaking the 60% mark in 2022, but the growth rate will have a downward trend. Referring to the S-curve of Northam (1979), my country will soon usher in the later stage of urbanization. Coupled with the stable implementation of the rural revitalization policy, the proportion of urban and rural employment will eventually remain stable.

4.2. Recommendations

The formulation of relevant policies fundamentally determines the quantity and direction of labor transfer between urban and rural areas. Therefore, forming a system of equal employment between urban and rural areas is the key to establishing a stable and harmonious employment situation between urban and rural areas.

In terms of rural-related enterprises, the current situation in rural areas is that there are many small and medium-sized enterprises, but these enterprises are struggling. At present, the rural areas have built a system environment to support entrepreneurship, such as microfinance, financial support, and tax incentives. It should continue to be used, deepened and improved so that it can fully play a leading role in the construction of beautiful rural areas. Encourage financial institutions to establish a special review mechanism to appropriately lower loan conditions and lower the threshold for entrepreneurship for enterprises or entrepreneurial projects that meet the requirements in rural areas. This can ensure that these enterprises can operate smoothly, drive the rural labor force to start their own businesses, and release employment opportunities.

As for the rural labor force, a very prominent feature of the labor force in rural areas is the lack of skills and low human capital. Therefore, it is necessary to strengthen the skills training of the rural labor force, empower the rural labor force, and alleviate the structural contradiction of employment. In addition, it is necessary to further deepen the policy of talents going to the countryside, and it is also necessary to provide talents with financial subsidies and policy incentives, which will help reduce the current situation of one-way flow of high-skilled labor from rural to urban areas, and cultivate a group of people who love the countryside, understand the countryside, and build the countryside. Senior working group.

In terms of the household registration system, local and non-local household registrations have greater restrictions on labor transfer and entrepreneurship, while differences in inter-provincial household registrations have relatively little impact. Therefore, a higher-level unified household registration system, such as the unified system at the provincial level, can be implemented, which can make public services benefit more people and help the labor force to start a business and find employment.

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